CORD BLOOD ZINC LEVEL IN TERM SMALL FOR GESTATIONAL AGE NEONATES

Dissertation submitted to

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For the award of the Degree of

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PAEDIATRIC MEDICINE

GOVT. KILPAUK MEDICAL COLLEGE & HOSPITAL

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APRIL - 2013

CERTIFICATE

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I declare that this dissertation entitled **"CORD BLOOD ZINC LEVEL IN TERM SMALL FOR GESTATIONAL AGE NEONATES"** has been conducted by me at Government Kilpauk Medical College and Hospital. It is submitted in part of fulfilment of the award of the degree of M.D (Paediatrics) for April 2013 examination to be held under **THE TAMIL NADU DR. M.G.R MEDICAL UNIVERSITY, CHENNAI.** This has not been submitted previously by me for the award of any degree or diploma from any other university.

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India is around 28%, accounting for 6- 8 million babies, which is around 40% of the global burden 1 . Low birth weight babies can be term- small for gestational age or preterm babies. In the western world, the major cause of low birth weight is
prematurity. In contrast to the western world, in India the
15
main cause of low birth weight is intrauterine growth restriction and not prematurity 2 . Thus around two third of the low birth weight neonates in India are term-small for gestational age babies and one third are preterm babies. Most of the low birth weight neonates in India weigh between 2000-2499 grams. These babies are at increased risk of morbidity and mortality. They are prone to immediate complications like asphyxia, sepsis, metabolic problems, hypothermia and they may also have feeding problems 3 . They are also prone to
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ABSTRACT

Birth weight is the single most important marker of perinatal and neonatal outcome. India contributes to 25% of the world's total neonatal deaths. The role of micronutrients in causing low birth weight in term babies has been unclear. This study was done to study the cord blood zinc level in term small for gestational age babies and to find whether low zinc level is an cause for low birth weight in term babies. We studied the cord blood zinc level of 50 term small for gestational age babies and 50 term appropriate for gestational age babies. Term small for gestational age babies were selected after excluding most of the causes of low birth weight. Maternal and baby's parameters were recorded. There was no significant difference in the cord blood zinc level between both the study groups. There was no significant difference in the maternal age, parity, mode of delivery and sex of the baby between both the study groups. Also there was no significance between zinc level and maternal age, parity, mode of delivery and the sex of the baby in both the study groups. Thus zinc deficiency alone cannot be an etiology for low birth weight in term babies.

INTRODUCTION

Birth weight is the single most important marker of perinatal and neonatal outcome. A new born weighing less than 2500 grams at birth irrespective of the gestational age is termed as a low birth weight neonate. The incidence of low birth weight in India is around 28%, accounting for 6-8 million babies, which is around 40% of the global burden[1]. Low birth weight babies can be term- small for gestational age or preterm babies.

In the western world, the major cause of low birth weight is prematurity. In contrast to the western world, in India the main cause of low birth weight is intrauterine growth restriction and not prematurity[2]. Thus around two third of the low birth weight neonates in India are term-small for gestational age babies and one third are preterm babies. Most of the low birth weight neonates in India weigh between 2000-2499 grams.

These babies are at an increased risk of morbidity and mortality. They are prone to immediate complications like asphyxia, sepsis, metabolic problems, hypothermia and they may also have feeding problems[3]. They are also prone to long term complications like growth failure, infection, developmental problems and malnutrition[3]. They are also at a high risk of developing diabetes mellitus, hypertension, coronary artery disease and stroke as suggested by the Barker hypothesis[4]. Thus improving the birth

weight of the neonate becomes a most important measure to prevent neonatal mortality.

Low birth weight neonates may have a low nutritional reserve, especially micronutrients, out of which zinc is an important one. Zinc is a trace element that is found in abundance next to iron. Zinc is a vital component of cell architecture and function. It is required for the production of many enzymes involved in nucleic acid metabolism and protein synthesis, which are the essential processes of growth. It has an important role in gene transcription. Zinc finger containing transcription factors play an important role in protein-DNA or protein –RNA interactions[5].

Zinc deficiency in mothers may lead to adverse pregnancy outcomes like spontaneous abortion, congenital malformations, preterm birth and low birth weight[5]. It can lead to poor weight gain, growth retardation, reduced immunocompetence and infection. However, two recent meta-analyses on randomised controlled trials of maternal zinc supplementation on pregnancy and infant outcomes revealed that zinc supplementation did not significantly improve the birth weight, head circumference or birth length[6,]. Thus this area remains a subject of debate.

This study aims at finding an association between cord blood zinc level and birth weight in term babies-both small for gestational age and

appropriate for gestational age. Several studies have been done on this subject, some of the studies have reported a positive correlation between zinc and birth weight, while some of the studies deny such correlation. After controlling many maternal and fetal factors that lead to low birth weight, the association between zinc level and birth weight is assessed. Thus this may assess the role of zinc as an etiology for low birth weight in term small for gestational age neonates.

SMALL FOR GESTATIONAL AGE BABIES

A neonate whose birth weight falls less than the 10th percentile for that gestational age is termed as small for gestational age[3].

Intrauterine growth retardation is termed as a condition in which a fetus is unable to achieve its genetically determined growth potential size and represents a deviation and a reduction in the expected growth pattern[8]. There is a diminished growth velocity of the fetus in atleast two intrauterine growth assessments.

FETAL GROWTH

Life begins when a sperm fertilises the ovum resulting in a microscopic monocellular zygote. It has X chromosome from the mother or the father and Y chromosome from the father. It has a enormous growth potential. It grows from a weight of 0.005 mg at conception to an average weight of 3kg at term. In the first trimester, growth occurs by differentiation of vital organs. Organogenesis is completed by 10-20 weeks. After 12 weeks, there is a rapid increase in weight.

During the second trimester, increase in length is proportionately greater than the increase in weight. In the third trimester there is a rapid increase in the weight of the fetus. The birth weight of a baby is 5% of the adult weight but the brain weighs 60% of the adult brain. Thus brain growth

is faster in the fetal period. In short, growth occurs by increase in cell number during the earlier weeks, and by increase in cell size during the later trimesters. Thus an insult in the early trimester affects the cell number leading to diminished growth potential. When the insult is late, baby will have normal number of small sized cells.

CLASSIFICATION OF SMALL FOR GESTATIONAL AGE BABIES[8]

1. Asymmetric IUGR
2. Symmetric IUGR

It is differentiated by the Ponderal index as below

$$\text{Ponderal index} = \frac{\text{weight in grams}}{(\text{length in centimetres})^3} \times 100$$

Asymmetric IUGR-Ponderal index < 2

Symmetric IUGR-Ponderal index >2

ASYMMETRIC IUGR

The fetus is affected during the later trimesters, thus the cell number is not affected. Only the cell size is affected. The head circumference and the brain growth are not affected which is called the brain sparing effect on the fetus. Thus their growth potential is not affected. They usually result from placental insufficiency or maternal malnutrition.

SYMMETRIC IUGR

The fetus is affected in the early trimester, thus the cell number is affected. The growth potential of the fetus is reduced. The baby is proportionately small. Weight, length and the head circumference are all affected. They are usually due to congenital anomalies or chromosomal abnormalities.

CAUSES OF SMALL FOR GESTATIONAL AGE BABIES[8]

1. Fetal factors
2. Maternal factors
3. Placental factors

FETAL FACTORS

1. Constitutional
2. Chromosomal syndromes.
3. Malformations
4. Infection
5. Multiple pregnancy.

MATERNAL FACTORS

1. Genetic
2. Constitutional
3. Pregnancy induced hypertension.

4. Ill health-heart disease, hemoglobinopathies, chronic anemia, asthma, vasculitis, chronic hypertension, diabetes, renal disease, pregnancy induced hypertension
5. Malnutrition
6. Anemia
7. Low socioeconomic status
8. Low pre pregnancy weight gain.
9. Drugs
10. Uterine malformatio
11. Smoking
12. Alcohol
13. Infections-TORCH

PLACENTAL FACTORS

1. Poor placentation
2. Pre eclampsia
3. Placental praevia
4. Abruptio placenta
5. Vascular abnormalities - single umbilical artery, velamentous insertion of the cord, twin to twin transfusion
6. Malformations - chorioangioma, infarction, circumvallate placenta

COMPLICATIONS[3]

1. Fetal hypoxia and intrapartum death due to placental dysfunction
2. Perinatal depression
3. Meconium aspiration
4. Pulmonary hemorrhage
5. Persistent pulmonary hypertension
6. Hypotension
7. Hypothermia
8. Hypoglycemia
9. Hypocalcemia
10. Polycythemia
11. Hyperbilirubinemia
12. Neutropenia
13. Thrombocytopenia
14. Acute tubular necrosis/renal insufficiency
15. Vulnerability to infections
16. Poor growth potential
17. Long term complications-diabetes mellitus, hypertension and coronary artery disease.

MANAGEMENT

DURING PREGNANCY[3]

1. The cause should be identified and treated.
2. Once the diagnosis is made, the fetal well being should be monitored by biophysical profile, fetal movement counts, serial ultrasound examination. Doppler evaluation of the placental flow can be used to detect uteroplacental insufficiency.
3. If early delivery is necessary, fetal lung maturity should be considered. antenatal steroids may be given when the delivery is planned before 34 weeks of gestation.
4. Decision of delivery
    a. Reversal of end diastolic umbilical artery flow – deliver
    b. Absent end diastolic umbilical artery flow
        i. >/=34 weeks-deliver
        ii. <34 weeks-daily non stress test
            deliver if NST nonreactive or BPP score>6.
    c. Oligohydramnios
        i. >/=34 weeks-deliver if cervix is favourable.
        ii. <34 weeks-daily NST-
            deliver if NST non reactive or BPP score>/=6 or absent end diastolic umbilical artery blood flow.
    d. Normal Doppler/BPP –continue antenatal surveillance.

DELIVERY

Steroids can be used if amniotic fluid analysis suggests pulmonary immaturity. When the placental blood flow is poor, the fetus may not tolerate labour and needs caesarean section. They are at a risk of perinatal hypoxia, meconium aspiration, hypothermia. Thus the resuscitation team must be ready to face them. Due to the above complications, the delivery should be planned in a higher centre with a good NICU.

POST PARTUM

Cause should be identified baby should be examined for congenital anomalies/stigmata of intrauterine infection[3]. Ponderal index should be determined baby should be nursed in a warm environment. Early breast feeding should be initiated to prevent hypoglycemia. The complications enlisted above have to be anticipated and treated effectively.

PROGNOSIS AND LONG TERM IMPLICATIONS

Small for gestational age babies have a lower risk of mortality when compared to preterm appropriate for gestational age babies. But they have a higher risk of mortality and morbidity when compared to term appropriate for gestational age babies[3]. They are at a higher risk for poor postnatal growth, neurologic impairment, delayed cognitive impairment and poor

academic achievement. According to Barker's hypothesis, they are prone to develop insulin resistance, diabetes and coronary artery disease[4].

Thus improving the birth weight of the baby decreases the morbidity in the later years thus improving the quality of life.

TRACE ELEMENTS

Trace element is an element that constitutes less than 0.01% of the total body weight[9]. They play a vital role in metabolic processes as they are components of many enzyme systems. They are a part of metalloenzymes and cofactors that are needed for enzymes[9]. Trace element deficiencies are being reported in humans and they have deleterious effects on the health, growth and development. Thus it becomes a field of interest for the Paediatricians.

Thirteen trace elements are considered to be most important for higher animals. They are in order of importance as follows [9]

1.Iron

2. Zinc

3. Copper

4. Fluoride

5. Iodine

6. Selenium

7. Manganese

8. Chromium

9. Cobalt

10. Molybdenum

11. Nickel

12. Silicon

13. Vanadium

Thus zinc stands second in order of importance next to iron. It also stands second next to iron in order of abundance in the human body. Thus zinc has progressed from a micronutrient of doubtful significance to a one with exceptional biologic importance .Thus it plays an important role in early development, both prenatal and postnatal. Thus its basic biochemistry, physiology and its metabolism in the maternal-placental unit and in the neonate has to be discussed to analyse its effects on the neonate.

ZINC

BIOCHEMISTRY OF ZINC

Zinc has an atomic weight of 65.39 and is adjacent to several first order elements of biologic importance. But its biochemical properties vary from other elements of similar atomic weight. Zinc is distributed evenly throughout the body. It is a component of metalloproteins and nucleic acids[5]. Two important properties of zinc that aid in biologic activity are:

1. Its capacity to form strong, yet readily exchangeable ligand binding.
2. Flexibility of the coordination geometry.

These two properties aid in the unique ability of the metal to interact with a wide range of organic ligands and thus its role in biologic systems[5]. The main aminoacids that supply ligands to zinc are histidine, glutamic acid, aspartic acid and cysteine[5]. Zinc affects the tertiary and the quarternary structure of the proteins which is important for the reactivity of the metal. Zinc participates in redox reactions in certain circumstances. In contrast to iron and copper, zinc per se has no oxidant properties and it remains in the divalent state. Thus this facilitates safe transport of zinc aiding in incorporation in to biologic systems[5]. The biological role of zinc can be recognized in the structure and function of proteins which includes enzymes, transcription factors, hormonal receptor sites and cell membranes. Zinc has several roles in DNA and RNA metabolism, it has a role in signal transduction, gene expression and apoptosis[5].

Zinc is a part of the structure of the enzymes. Yet its importance lies in being a component of the catalytic site of the several metalloenzymes. Many of the enzymes involved in cellular proliferation, differentiation, nucleic acid metabolism and growth are zinc dependent enzymes. Several zinc finger containing proteins have been identified. Zinc finger motif is a tetrahedral structure containing recurring pattern of aminoacids with conserved residues of cysteine and histidine to which zinc binds[5]. Almost >3% of the human genes contain zinc finger domains. Zinc plays an

important role in transcription, thus it mediates and modulates gene expression. Hence it is essential for the early development.

Zinc is an important regulator of apoptosis. It protects the cell from apoptosis as it downregulates the main pathways involved in apoptosis. It has also got a direct influence on the caspases which are the key enzymes in apoptosis. Thus a decrease in the intracellular zinc can trigger the apoptotic pathways leading to activation of caspases[5].

Zinc is involved in signal transduction[5]. Zinc is sequestered in the presynaptic vesicles of the neurons containing zinc. Zinc is released from these neurons into the cleft from where it is recycled back to the neurons. This vesicular zinc that is released acts as a neurotransmitter and a neuromodulator. The main role of this vesicular zinc lies in the tonic modulation of the excitability of the brain.

Vesicular zinc rich regions include the hippocampus which is most sensitive to zinc deprivation resulting in brain dysfunction, learning disability and high susceptibility to seizures. The above facts reinforce the importance of zinc for normal neuronal function. Thus normal neuronal function needs a normal zinc homeostasis[5]. Metallothionein is a small intracellular protein with a metal binding capacity. It has four isoforms. It is usually found in all the tissues. It is found in plenty in liver, pancreas,

intestine and the kidney. Isoforms 1 and 2 are abundant. Isoform 3 is found in brain. Zinc is an inducer of metallothionein. Zinc's role in transcription is related to metal response element-binding transcription factor-1 which is a cellular zinc sensor[5]. Other inducers of metallothionein are cytokines interleukin-6, tumour necrosis factor alpha and stress hormones – corticosteroids and catecholamines. Metallothionein is an antioxidant. Factors that induce maternal hepatic metallothionein during early trimesters may direct the zinc from the conceptus to the maternal liver. Thus the fetus may become zinc deficient. This is the mechanism that occurs in fetal alcohol syndrome[5].

PHYSIOLOGY OF ZINC

Zinc is absorbed in the small intestine by active transport. Zinc homeostasis is maintained by both uptake and endogenous secretion. This is done by two families of zinc transporters, the ZIP family (1-5) and ZnT family (1-14)[5,9]. ZIP family regulates uptake of zinc into the cells. ZnT family regulates zinc efflux and intracellular compartmentalization. These are affected by zinc intake. It is transported in serum as a bound form with albumin and alpha 2 macroglobulin. Further metabolism occurs in the liver.

MATERNAL METABOLISM

There is an increase in the metallothionein in the liver which may increase the zinc store. But when the plasma zinc is diverted to the liver in fetal alcohol syndrome, zinc deficiency may occur. As the pregnancy progresses, there is a decrease in the maternal zinc level[5]. When this decrease is excessive due to maternal zinc deprivation or abnormal metabolism, zinc deficiency may occur.

PLACENTAL AND FETAL METABOLISM

Transfer of zinc from the mother to the fetus starts with the uptake of zinc in to the placental syncytiotrophoblast. This is usually from the maternal plasma pool by a carrier mediated process[5]. It also occurs from zinc bound to protein by an endocytic mechanism. Affinity of the placental syncytiotrophoblast microvillus membrane vesicles to zinc does not vary with the gestational age or the maternal plasma level.

The uptake capacity of zinc is higher in preterm than in term and with low maternal zinc level. Changes in fetal zinc for a short time does not cause a change in placental zinc transfer. Thus there is no immediate adjusting mechanism for fetal zinc deprivation[5]. Fetal hepatic zinc increases as the gestation increases. This decreases late in the third trimester. Metallothioneins are essential for the maintenance of pregnancy.

MAMMARY GLAND METABOLISM

Concentration of zinc in the milk is regulated by a set of transporters ZnT1, ZnT2 and ZnT4[5].Vitamin A may have a role in zinc metabolism in the mammary gland. There is a decrease in the zinc in the human milk as the lactataion progresses. Rarely when there is a deficiency in the zinc transporter ZnT4[5], the clinical syndrome of acrodermatitis enteropathica results.

ZINC HOMEOSTASIS

Small intestine plays an important role in zinc homeostasis. Maximum absorption is by a saturable transport mechanism. Fractional absorption of zinc declines with raising the zinc intake and viceversa. Apart from the facilitated diffusion, passive diffusion also plays a role and this contributes when the facilitated diffusion is saturated[5]. The major routes of excretion of endogenous zinc are the pancreas and the small intestine. Thus zinc homeostasis depends on the regulation of the excretion of endogenous zinc. In term infants, this regulation of endogenous zinc via the small intestine is well developed.

ZINC DEFICIENCY IN THE CONCEPTUS AND EARLY INFANCY

EMBRYOGENESIS

Zinc is critically needed for the development of the oocyte and the embryo. There is evidence that in mothers with acrodematitis enteropathica, severe zinc deficiency resulted in neural tube defects and other congenital malformations .There are studies where adequate maternal supplementation from 8-10 weeks of gestational age resulted in a significant decrease in the incidence of the malformations.

FETAL DEVELOPMENT

The effects of maternal zinc deprivation during fetal development in rodent models are intrauterine growth retardation and decreased nestin which is a marker of proliferation of the neural stem cell. Human studies show controversial reports on the effect of maternal zinc supplementation on the gestational age at delivery and birth weight[6,7]. But there are reports that show a decrease in the morbidity of infants with maternal zinc supplementation during the second and third trimesters. These reports explain the role of zinc on the developing immune system.

INFANCY

Zinc deficiency in infancy has been classified in to

1. acute or severe
2. mild forms.

The prototype of the acute severe presentation is acrodermatitis enteropathica[5]. It is an autosomal recessive disorder. It usually presents between 2 and 6 months of age, though the presentation may also be delayed in zinc fortified formula fed infants. Breast milk was found to have some benefit as breast fed infants had a later onset of the disease compared to unfortified formula fed infants. The most pathognomonic clinical feature is the skin rash over the body orifices and the extremities. The triad of clinical features include diarrhoea, hair loss and the typical skin rash[5].

When untreated it results in apathy, growth failure and recurrent infections, leading to death. Zinc usually affects cells that have a rapid turnover that includes the skin, intestinal mucosa and the immune system. Thus immune system abnormalities and growth failure are observed in acrodermatitis enteropathica. Globally, zinc deficiency is a major public health problem. Studies indicate that around 20-25% of diarrhoea and 40% of pneumonia can be prevented by adequate zinc supplementation[5]. Improvements in linear growth, weight gain, brain function and

development have been documented after correction of the zinc deficiency. Low birth weight babies are at a higher risk from zinc deficiency and its effects. In our country, zinc supplementation from the neonatal period have shown improvements in growth, decrease in morbidity due to decrease in infection. The brain function and development is also better after zinc supplementation.

ZINC AND DIET

SOURCES

Zinc is rich in oysters, liver, meat, cheese, legumes and whole grains[9].

RECOMMENDED DIETARY ALLOWANCE[9]

INFANTS

0-6 months-2mg/day

7-12 months-3 mg /day

CHILDREN

1-3 years-3 mg/day

4-8 years-5 mg/day

ADOLESCENT MALES

9-13 years-8mg/day

14-18years-11 mg/day

ADOLESCENT FEMALES

9-13 years-8 mg/day

14-18 years-9 mg/day

Zinc absorption is higher from human milk than in cow's milk. This is due to its higher bioavailability as zinc is loosely bound to citrate and albumin in human milk[9]. In cows milk zinc is tightly bound to casein resulting in low bioavailability. Phytate rich foods limit zinc absorption[9]. High intake of foods rich in phytate and low intake of foods rich in zinc such as meat results in zinc deficiency in our country. High level of iron supplementation may impair the zinc absorption[9]. Combined supplementation of zinc and iron resulted in a lower zinc status than with zinc supplements alone. As both are essential trace elements. The correct dosing in which the two elements do not react adversely have to be identified to attain the maximum benefits of zinc supplementation.

The concentration of zinc in human milk in the early post natal period is around 2-3mg/L. It decreases to around 0.5mg/L at around 6 months[9]. So this may be inadequate for the baby for its growth. Moreover this is the period when the complementary foods are introduced and this period is critical for the baby as it is prone to multiple nutrient deficiencies.

REVIEW OF LITERATURE

A study on umbilical cord blood nutrients in low birth weight babies in relation to birth weight and gestational age by K E Elizabeth et al[10].

In this study, several nutrients in the cord blood of newborns were studied. The study groups included term appropriate for gestational age babies (249), term Small for gestational age babies (192) and preterm babies (59).The nutrients studied included total protein, albumin, cholesterol, triglycerides, calcium, magnesium, zinc and iron. All these parameters were lowest in preterm followed by term small for gestational age and Term appropriate for gestational age babies.

Peripheral blood leucocyte zinc depletion in babies with intrauterine growth retardation by N Meadows et al [11]

In this study, peripheral blood leucocyte and plasma zinc level of mother and babies were done. The study groups were normal term (63), preterms (20), acute IUGR (term SGA) (19) and prolonged IUGR (term IUGR) (8). Leucocyte zinc was comparatively low in acute IUGR, but was insignificant. Leucocyte zinc level was significantly low in prolonged IUGR, was normal in term controls and slightly higher in preterms. Plasma zinc level in the fetus was comparatively the same in all the four groups.

There was no significant relation between the maternal and fetal plasma zinc level. There was a significant correlation between the leucocyte zinc level in the mother and the fetus.

Some essential elements in maternal and cord blood in relation to birth weight and gestational age by S Srivastava et al [12]

Maternal and cord blood level of three trace elements, zinc, copper and iron was studied in 54 mothers and babies. The study groups were low birth weight and normal birth weight babies. Zinc level in the cord blood was low in low birth weight babies but was not significant. There was no significant difference between the gestational age and cord blood zinc level. A weak significant correlation existed between the cord blood iron and birth weight. Another weak significant relation was between the gestational age and the cord blood iron and copper level.

Leucocyte and plasma zinc in maternal and cord blood –relationship to gestational age and birth weight by Aminul Islam et al[13]

In this study, 63 mothers and babies were included. The study groups were term appropriate for gestational age (33) and term small for gestational age or preterm (30). Maternal and cord blood zinc level had no relation to birth weight. Plasma copper had an inverse relationship to zinc levels. The

cord blood zinc levels were significantly greater when compared to the maternal zinc level.

Zinc and birth weight in uncomplicated pregnancies by T T Lao et al[14]

Zinc status was studied in 59 primiparous and 27 multiparous mothers who delivered term babies. The parameters studied were plasma zinc level of the mother and the fetus, tissue zinc level from the mothers pubic hair and the umbilical cord. No correlation was found between the maternal or fetal plasma zinc level and the birth weight. There was no correlation between the maternal or fetal tissue zinc level and the birth weight as well. Zinc status was significantly higher in the plasma of the neonates than in the maternal plasma. Tissue zinc concentration was significantly higher in the mother than in the neonate. There was no significance between parity and the neonates zinc status.

Serum zinc and copper level in the maternal and cord blood of neonates by A S K Iqbal et al[15]

Maternal and cord blood zinc level were assessed in 65 mothers and their babies. Out of these 33 were term babies and 32 were preterm babies. Cord blood zinc level had no significant difference between the term and preterm babies, but copper levels were higher in preterm than the term babies. There was no significant correlation between the cord blood zinc

level or maternal blood zinc level and the birth weight. But there was significant relation between the birth weight and the cord blood copper level. There was no significant relation between the cord blood zinc level or maternal zinc level and the gestational age of the baby.

Maternal and cord blood zinc level in healthy pregnant Jordanian women by S M Awadallah et al [16]

Maternal and cord blood levels of zinc, copper and iron were estimated in 92 mothers and their babies. Serum zinc level was significantly low in the cord blood than in the maternal blood. As the pregnancy progressed the serum zinc level decreased while the serum copper level increased. Serum iron level was unchanged in all the three trimesters. There was a significant positive correlation between the cord blood zinc level and the weight of the baby at birth.

Association between calcium, magnesium, phosphorus, copper and zinc in cord plasma and erythrocytes – gestational age and growth variables of full term new borns by Michelle Speich et al[17]

Cord blood levels of several nutrients were studied in term appropriate for gestational age babies. Only uncomplicated pregnancies were included and all were delivered by labour naturale. All were healthy

mothers and had no chronic diseases. Erythrocyte zinc and plasma zinc were the most significant variables responsible for birth weight. A significant positive correlation was observed between the gestational age and the growth variables.

Profile of trace element concentrations in the feto placental unit in relation to fetal growth by Osada H, Watanabe Y et al[18]

Serum levels of manganese, magnesium, iron, copper, zinc and selenium were determined in 21 mothers along with their babies who had intra uterine growth restriction. 30 term appropriate for gestational age babies along with their mothers were also included as controls. Copper, selenium, magnesium and zinc were elevated in the umbilical arterial blood in IUGR babies. There was no significant difference in the level of these trace elements between the study groups.

Trace elements and growth factors in the perinatal period by Diaz Gomez NM et al [19]

In this study, cord blood level of copper, zinc, insulin like growth factor I levels were measured in all the three study groups, term, preterm, term low birth weight. It was found that the cord blood zinc level was low in preterm and intrauterine growth retardation babies.

Maternal zinc and cord blood zinc, insulin like growth factor-1, insulin like growth factor binding protein 3 levels in small for gestational age neonates by Akman et al[20]

In this study, cord blood level of zinc, insulin like growth factor -1, insulin like growth factor -1 binding protein -3 were measured. Term small for gestational age babies (22) and term appropriate for age babies (34) and their mothers were included. There was positive correlation between maternal and neonatal zinc level. Zinc was not low in term SGA babies.IGF1 and IGFBP3 were significantly low in SGA than the AGA babies. Significant correlation was found between IGF1, IGFBP3 and birth weight.

A study of serum zinc level in cord blood of neonates and their mothers by Jeswani et al [21]

Cord blood zinc levels were estimated in the cord blood of 60 new born babies. The study group consisted of term AGA, term SGA and preterm babies. Serum zinc level was significantly low in term SGA and preterm than term appropriate for gestational age babies. There was a positive correlation between gestational age and cord blood zinc level and a negative correlation between the maternal blood zinc level and gestational age. There was a positive correlation between cord blood serum zinc level and birth weight.

Assessment of maternal fetal status of some essential trace elements in pregnant women; relationship with birth weight and placental weight by Al-Saleh E et al[22]

In this study, cord blood level of copper, iron, zinc and selenium were assessed in the maternal and cord blood .The study group consisted of term –normal birth weight babies. There was no correlation between the maternal zinc level and the birth weight of the neonate. There was a negative correlation between the umbilical venous copper level and birth weight. There was a positive correlation between the cord blood iron or molybdenum and placental weight and a negative correlation between the cord blood zinc level and placental weight.

Maternal zinc indices and small babies by George et al [23]

In this study, zinc status was assessed in mothers of term appropriate for gestational age and term small for gestational age babies. Maternal zinc level had no positive correlation with the birth weight of the babies. Thus this study concluded that maternal zinc was not a cause for intrauterine growth restriction.

Zinc level of maternal and umbilical venous blood in normal, small for gestational age and large for gestational age by Doszpod J et al [24]

In this study, cord blood zinc were measured in 482 deliveries.241 cases had normal birth weight babies, 241 mothers had babies with intrauterine growth retardation. Zinc concentration was significantly high in IUGR babies. Zinc level in 91 IUGR babies were lower than their mothers. There was no significant difference in the maternal or cord blood of 59 large for date newborn and 56 normal newborns.

Zinc levels in human milk and umbilical cord blood by A Frkovic et al[25]

Zinc levels in the human milk (n=29) and the umbilical cord blood (n=42) were estimated .Among the forty two babies, thirty eight were term babies and only four were preterms. They analysed the zinc levels with regard to maternal factors .According to this study parity had significance when compared with the zinc level in both milk and cord blood. Primiparae had a higher zinc content level. Young mothers had a higher zinc concentration. There was a weak association between the zinc levels in the umbilical cord and the birth weight, head circumference of the neonates.

Intrauterine growth restriction and zinc concentrations in term infants by Renato Takeshi Yamada et al[26]

This study analysed the plasma zinc and erythrocyte zinc level in intrauterine growth restricted babies. The babies were divided in to three groups –without intrauterine growth restriction, with mild to moderate intrauterine growth restriction, severe intrauterine growth restriction based on the Kramer index. Plasma zinc decreased towards the first month of life. Erythrocyte zinc level increased towards the first month of life in IUGR babies.

A positive association between maternal serum zinc and birth weight by Neggers Y et al [27]

In this study four hundred and seventy six women attending the prenatal clinic were recruited and their serum zinc levels were ascertained. The birth weight of all their babies were recorded and analysed .According to this study, mothers with a lower zinc level had low birth weight compared to those with higher zinc level. Mothers whose zinc level fell in the lowest quartile had significantly low birth weight babies than those mothers whose zinc level were in the upper three quartiles.

Serum zinc and copper in maternal and umbilical cord blood relation to the course and outcome of pregnancy by Bro S et al [28]

In this study serum zinc and serum copper levels were estimated in the mother and the baby. They were analysed in three groups-term normal weight babies, term low birth weight babies and preterms .Serum copper level in small for date babies and mothers were in the higher range .There was no significance between the serum zinc level and birth weight in small for date babies. Preterms had lower serum copper level than term babies and there was no difference in the serum zinc level when compared with the term babies. Those babies with malformations did not have any difference in the serum zinc and copper level when compared with the normal term babies.

Relationship of zinc and copper in maternal and cord blood and birth weight Atinmo T et al [29]

In this study fifty pregnant women were selected for the study. Out of these twenty delivered babies with birth weight ranging from 1500 grams to 2500 grams, thirty delivered babies with birth weight more than 2500 grams. The cord blood and the maternal blood were collected and sent for analysis of serum zinc and copper. The plasma zinc was significantly low in both the maternal and cord blood of low birth weight babies. Plasma copper was

significantly elevated in the maternal and cord blood of the low birth weight babies. Serum zinc level in the maternal blood was less than that of in the cord blood. Serum copper level was higher in the maternal blood than the cord blood.

Maternal hypozincemia and low birth weight babies by Prem Prakash Singh et al [30]

In this study blood was collected from ninety two pairs of mothers and babies. All the mothers delivered their babies vaginally and all the babies were full term babies. Blood was analysed for serum zinc level. In this study they found that the mothers who had a zinc level less than 500 micrograms/litre had a significantly high level of low birth weight babies.

Plasma zinc and copper in pregnant Nigerian women at term and their new born babies by Okonofua FE et al [31]

The sample population included 26 normal Nigerian women and their neonates. Maternal and cord blood zinc level were determined and the parameters were analysed. In this study there was no significant correlation between the maternal and cord blood zinc. Maternal copper level had a weak correlation with the cord blood copper. Birth weight did not have any

significant correlation with the cord blood zinc. Maternal and cord blood copper had an inverse relationship with birth weight.

Plasma trace elements in maternal and cord blood in Poland, relation with birth weight, gestational age and parity by Wasowicz et al [32]

In this study the concentrations of zinc, selenium and copper were estimated in the plasma of sixty four mothers at delivery. The study population also included sixty four neonates, twelve infants aged 2-12 months and fifty eight non pregnant women. There was no significant difference between maternal, cord blood zinc and birth weight of the neonate. There was a significant correlation between selenium level in the mother and the baby and birth weight. Plasma copper level also had significance with birth weight. There was no significant correlation between maternal parity and trace elements level.

Serum zinc, copper and iron status in maternal and cord blood by Chitra Upadhyaya et al [33]

The study population of this group was around eighty pregnant women. Among them, forty six of them were not anemic and thirty four of them had anemia. Serum zinc level in pregnancy was significantly reduced. But zinc in newborns was significantly higher than that of their mothers.

This study highlighted the interactions between the micronutrients. Iron affects the bioavailability of zinc and copper. Zinc affects the bioavailability of iron and copper.

Maternal zinc and intrauterine growth retardation by Simmer K et al[34]

Zinc level was measured in the plasma, erythrocyte, polymorphonuclear and mononuclear white cells of the mothers who gave birth to term AGA babies and term SGA babies. The mean plasma zinc level in the mother was low compared to controls but the zinc level in polymorphonuclear and mononuclear white cells were unchanged. Erythrocyte zinc did not correlate with the anthropometry of the baby.

Study of serum zinc in neonates and their mothers in Shimla hills by Bahl L Chaudhuri L S Pathak R M [35]

In this study, 159 mothers and their babies were included. The babies were classified in to term appropriate for gestational age, term small for gestational age, term large for gestational age, preterm appropriate for gestational age, preterm small for gestational age and preterm large for gestational age serum zinc level in both the maternal and cord blood samples were analysed. Serum zinc level in small for gestational age babies were significantly lower than the appropriate for gestational age babies in both the preterm and term groups.

Effect of zinc supplementation on pregnancy and infant outcome Janet C King, Benjamin W Chaffee [6]

This study is a meta analysis that included 20 randomised control trials. The trials were across the five continents from 1977 to 2008.The dosage range of zinc was from 5 to 50 mg/day. There was no significance between zinc supplementation and fetal growth parameters like birth weight, length or head circumference. There was a weak significance between zinc supplementation and preterm births. This might be due to a reduction in the incidence of maternal infection.

A study on the effect of zinc supplementation prenatally on the birth weight –a meta analysis by Samson G. Gebreselassie [7]

17 randomised controlled trials were analysed for the effect of zinc supplementation in mothers on the birth weight of the baby. Out of these, four studies were from United States of America, six from Asian countries, three from United Kingdom, three from the Latin Countries and only one from Africa. Thirteen RCTs found no association, three found a positive association and one found a negative association. This meta analysis found no association between maternal zinc supplementation and the birth weight.

Zinc supplementation for improving pregnancy and infant outcome by Mahomed K et al [36]

The objective of this study was to find the effects of zinc supplementation in pregnancy on the maternal, fetal and neonatal outcomes. Seventeen randomised control trials were included in the study. Four studies were from United States of America, three from United Kingdom, two each from Indonesia and Peru, one trial each from Nepal, Pakistan, Bangladesh, Denmark, Chile and South Africa. Zinc supplementation resulted in a small significant reduction in the incidence of preterm births. But there was no significant association between maternal zinc supplementation and low birth weight.

Birth weight and early neonatal outcome in infants born to malnourished pregnant women given multi micronutrient supplementation by R Chakrabarti et al [37]

The study population was 350 pregnant women with body mass index <21 and the haemoglobin level between 7-9 g/dl. They were divided into three groups. One group was supplemented with micronutrients from 20 weeks till term, other group was supplemented from 20 to 30 weeks and the last group was given placebo. The birth weight was significantly higher in the group that was supplemented with micronutrients for a longer time.

Morbidity was also significantly decreased in the same group. Thus they concluded that micronutrient supplementation reduced the risk of low birth weight babies.

Randomised control trial of the effect of zinc supplementation on pregnancy outcome in Bangladesh by Osendarp et al [38]

It was a double blind placebo controlled trial in which 559 women were enrolled and the anthropometry of 410 new borns were measured. Serum zinc level was significantly high in the zinc supplemented group at 7 months of gestation. There was no significance between zinc supplementation and birth weight, length or the head circumference. There was no difference in the incidence of prematurity.

Maternal zinc supplementation in pregnant women of Peru by Caulfield LE et al [39]

1295 mothers were include in the trial. They received 60 mg of iron with or with out 15 mg zinc.At delivery 1016 remained in the study. Neonates' anthropometric parameters were measured .This study found no difference between maternal zinc supplementation and birth weight or the gestational age of the baby. There was also no significance in the incidence of preterm or post term. There was no difference in the anthropometric measures like head circumference, crown heel length, chest circumference,

mid upper arm circumference, calf circumference and skin fold thickness between both the study groups.

Effect of zinc supplementation on the pregnancy outcome by Goldenberg RL Tamura T Neggers Y et al [40]

Around five hundred and eighty women were enrolled in study. Those who had low plasma zinc level at enrolment were randomized receive 25 mg of zinc from around 19 weeks of gestational age. One group received zinc in addition to a multivitamin tablet, another group received multivitamin tablet with a placebo. The babies of the zinc supplemented group had a significantly greater weight than the other group.

Potential contribution of maternal zinc supplementation during pregnancy to maternal and child survival by Laura E Caulfield et al [41]

This is a review of the effects of maternal zinc supplementation on pregnancy and infant outcome. Mild to moderate zinc deficiency can be a relatively common one but the importance of the degree of deficiency of zinc is not well understood. The motive of this study was to bring the importance of zinc in to light as it may be related to fetal development and growth, adverse pregnancy outcomes. They concluded that more

supplementation trials are needed to assess the effect of zinc supplementation on the pregnancy and neonates' outcome.

Effect of prenatal zinc supplementation on the birth weight by Mahama Saaka et al [42]

This study is a double blind randomised controlled study. Almost 600 women in Ghana were enrolled .One group was assigned to receive 40 mg of zinc and 40 mg of iron as ferrous sulphate, the other group was assigned to receive only iron as ferrous sulphate. There was no significant difference in the mean birth weight of the two groups. The effects of prenatal zinc supplementation on the birth weight would have been masked by the effects of iron. They concluded that iron zinc supplementation was effective in increasing the weight of the neonate only among anemic mothers and not in mothers with good iron stores.

OBJECTIVES OF THE STUDY

1. To study the serum zinc level in the cord blood of Term- small for gestational age babies.

2. To determine whether low serum zinc level is an etiology for low birth weight in term small for gestational age babies and to assess their anthropometric outcome during the neonatal period.

MATERIALS AND METHODS

STUDY DESIGN : Prospective case control study

PLACE : Department of Paediatrics,
Government Kilpauk Medical college Hospital

STUDY PERIOD : April 2011-June 2012

STUDY POPULATION : 50 Term appropriate for gestational age babies and 50 Term small for gestational age babies born at Government Kilpauk medical college hospital.

STUDY DEFINITION

TERM BABY

A baby whose gestational age falls between 37 completed weeks and 41 6/7 weeks, that is 260-293 days.

SMALL FOR GESTATIONAL AGE

It is defined as a baby whose birth weight falls below the 10th centile in the Lubchenco growth chart.

APPROPRIATE FOR GESTATIONAL AGE

It is defined as a baby whose birth weight falls between 10th centile and 90^{th} centile in the Lubchenco growth chart.

INCLUSION CRITERIA

50 term appropriate for gestational age babies and

50 term small for gestational age babies born at

Government Kilpauk medical college hospital.

EXCLUSION CRITERIA

1. Babies with features of chromosomal abnormalities, intrauterine infection or with congenital malformations or those born of multiple gestation.
2. Babies of mothers with severe malnutrition (body mass index<18.5), severe anaemia, diabetes mellitus, gestational diabetes, pregnancy induced hypertension, chronic illness, teratogenic drugs, placental abnormalities.
3. Those babies who develop significant illness requiring admission in the neonatal intensive care unit.

METHOD

50 term-small for gestational age babies are selected based on the inclusion and exclusion criteria, their cord blood samples are collected from the placental end of the cord after obtaining consent from the baby's mother or the father for determination of the serum zinc level. Cord blood samples are also collected from term-appropriate for gestational age babies with no

risk factors. Maternal history is noted. Gestational age is estimated by New Ballard scoring system. Birth weights are plotted against gestational age in Lubchenco growth charts to assess if they are small for gestational age or appropriate for gestational age. Physical examination of the babies are done. Babies requiring admission are taken to the neonatal intensive care unit.

Well babies are given to the mothers for exclusive breast feeding. Mothers are advised to follow up at new born Out Patient Clinic every week.

At every week of visit, anthropometry measurements are taken. Babies are weighed on a electronic weighing scale with the accuracy of 10 grams. Length is measured by a infantometer accurate to 0.5 cm. Head circumference and chest circumference are measured by a non stretchable inch tape accurate to 0.1 cm .Mothers are also enquired regarding the babies‘ illness. Those babies who develop significant illness requiring admission in neonatal intensive care unit are excluded from the study.

Serum zinc level is estimated by end point nitro paps dye binding colorimetric method. The data collected are analysed using SPSS version 16.0. Qualitative data like parity, mode of delivery, sex of the baby are analysed by Pearson Chi square test. Quantitative data like maternal age, zinc level, weight, length and head circumference are analysed by student’t’ test.

LABORATORY ASSESSMENT OF ZINC

In this study, zinc is estimated by end point nitro PAPS dye binding method.

PRINCIPLE OF THE METHOD

Nitro PAPS reacts with zinc in alkaline solution to form a purple coloured complex. Its absorbance is measured at 575 nm in a spectrophotometer.

REAGENTS USED

REAGENT –A

Borate buffer 370 mM, pH 8.20, salicylaldoxime 12.5mM, diethyl dioxime 1.25 mM, surfactants and preservatives.

REAGENT –B

Nitro PAPS.

REFERENCE VALUE

Serum Zinc-70-150 micrograms/decilitre.

LINEARITY

The method is linear up to 1000micrograms/decilitre.

SENSITIVITY/LIMIT OF DETECTION is 5 micrograms/decilitre.

OBSERVATION AND RESULTS

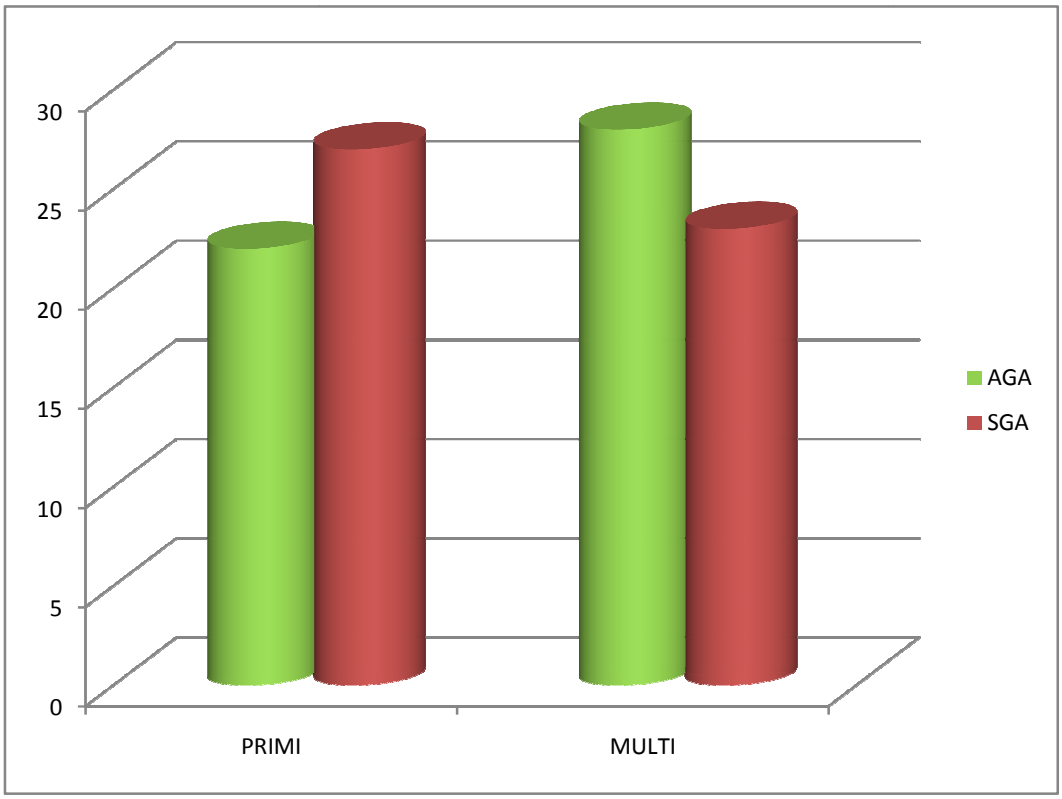
TABLE – 1 PARITY - AGA VS SGA

	AGA		SGA		TOTAL
	NO.	%	NO.	%	
PRIMI	22	44	27	54	49
MULTI	28	56	23	46	51
TOTAL	**50**	**100**	**50**	**100**	**100**

PEARSON CHI SQUARE TEST

P VALUE = 0.212 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance in the parity of the mother between the AGA and SGA group. Thus maternal parity was comparable in both the groups.



From the above bar diagram, we can infer that primipara mothers had more small for gestational age babies than multipara mothers and multipara mothers had more appropriate for gestational age babies, but the significance is not statistically significant.

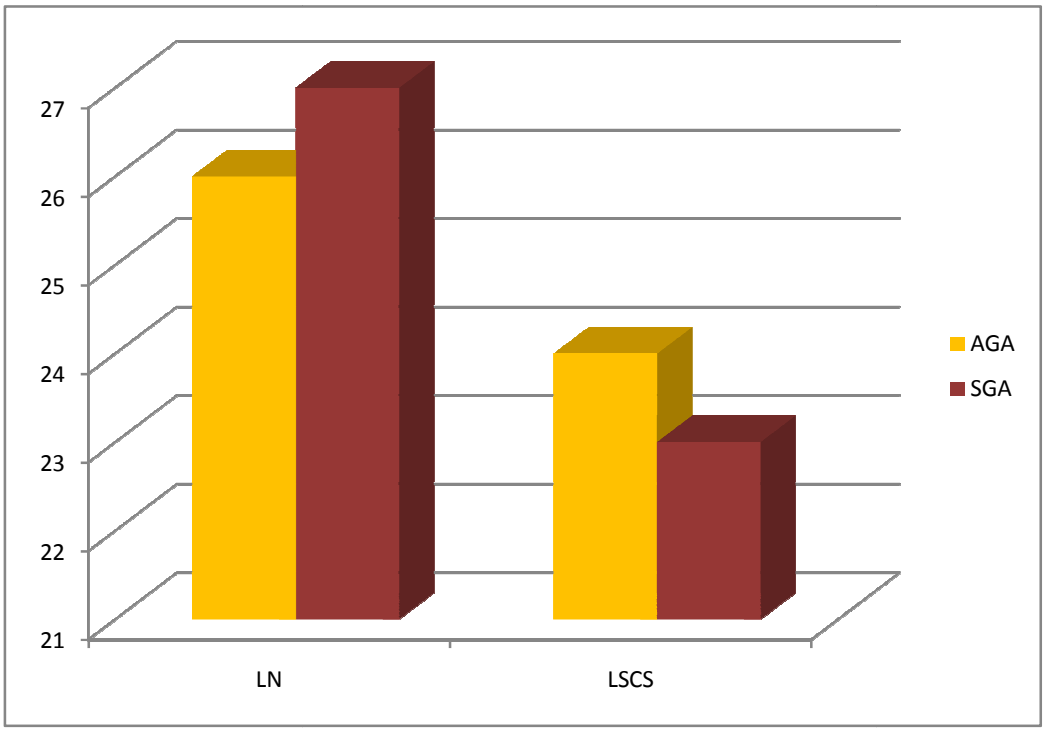
TABLE – 2 : MODE OF DELIVERY AGA VS SGA

	AGA		SGA		
	NO.	**%**	**NO.**	**%**	**TOTAL**
LN	26	52	27	54	53
LSCS	24	48	23	46	47
TOTAL	**50**	**100**	**50**	**100**	**100**

PEARSON CHI SQUARE TEST

P VALUE = 0.500 NOT SIGNIFICANT

The above tabulation shows that there was no significance in the mode of delivery between the AGA and SGA group. Thus both the groups were comparable in terms of mode of delivery of the baby.



From the above diagram, we can infer that most of the babies under the study were delivered by labour naturale. But there is no significance between the appropriate for gestational age and small for gestational age babies in terms of mode of delivery.

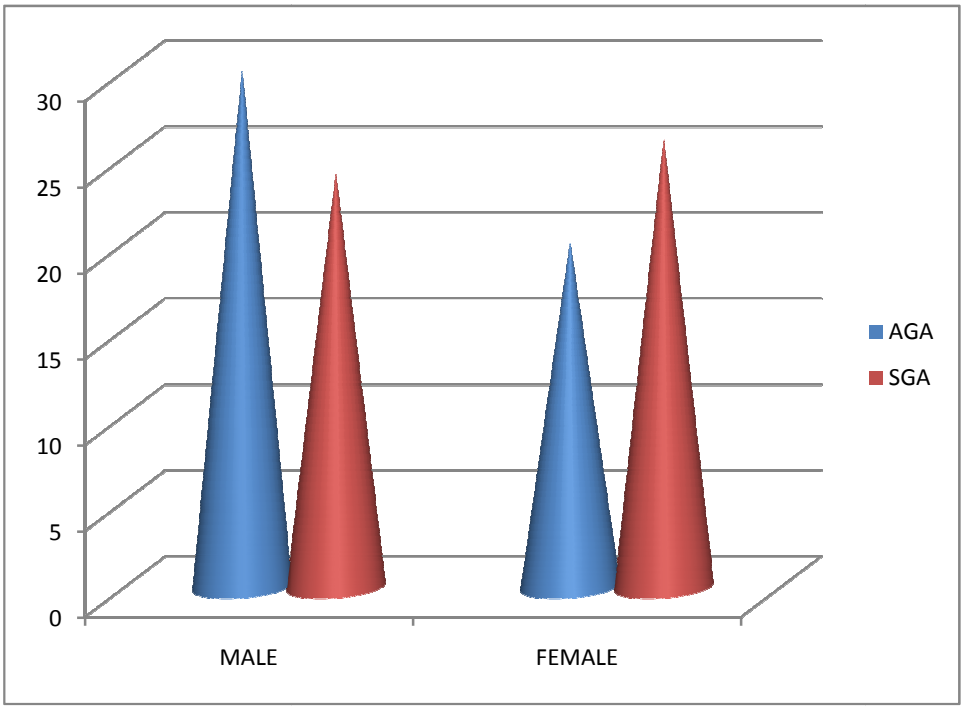
TABLE – 3 : SEX OF THE BABY AGA VS SGA

	AGA		SGA		
	NO.	**%**	**NO.**	**%**	**TOTAL**
MALE	30	60	24	48	54
FEMALE	20	40	26	52	46
TOTAL	**50**	**100**	**50**	**100**	**100**

PEARSON CHI SQUARE TEST

P VALUE = 0.324 **NOT SIGNIFICANT**

The above tabulation shows that there was no significant difference in the sex of the baby between the AGA and SGA group. Thus both the groups were comparable in terms of sex of the baby.



From the above diagram, we infer that the female babies were more in the small for gestational age group and males were higher in number in the appropriate for gestational age group. But there was no statistical significance in the sex of the baby between both the groups.

TABLE - 4 : MATERNAL AGE - AGA VS SGA

	MATERNAL AGE (YEARS)	
	AGA	**SGA**
MEAN	24.56	24.96
SD	3.357	4.262
MINIMUM	19	19
MAXIMUM	32	36

STUDENT 'T' TEST

P VALUE =0.603 **NOT SIGNIFICANT**

The above tabulation shows that the mean maternal age in the AGA group was 24.56 and in the SGA group was 24.96. Thus there was no significant difference in the maternal age between AGA and SGA groups.

TABLE - 5 : CORD BLOOD ZINC-AGA VS SGA

	ZINC LEVEL(MICROGRAM/DECILITRE)	
	AGA	**SGA**
MEAN	97.074	92.472
SD	8.131	15.880
MIN	85.3	58.7
MAX	140.8	140.4

STUDENT 'T' TEST

P VALUE- 0.071 **NOT SIGNIFICANT**

The above tabulation shows that the mean cord blood zinc level in AGA babies was 97.074 microgram/decilitre and in SGA babies was 92.472 microgram/decilitre Thus there was no significant difference between the cord blood zinc level in AGA and SGA babies.

DESCRIPTIVE STATISTICS

BOTH AGA AND SGA

TABLE 6

	MEAN	SD
ZINC(MICROGRAM/ DECILITRE)	94.773	12.763
WT(KG)	2.622	0.578
LEN(CM)	49.040	1.629
HC(CM)	36.045	0.818

The above tabulation shows the mean cord blood zinc level, weight, length and head circumference of the entire study population.

TABLE - 7 CORRELATION BETWEEN ZINC AND ANTHROPOMETRY AT BIRTH

	ZINC	
PARAMETERS	**p VALUE**	**r VALUE**
WT	0.087	0.172
LEN	0.328	0.099
HC	0.621	0.050

The above tabular column shows that there is a weak positive correlation between zinc level and weight, length and head circumference at birth.

But there is no statistical significance between cord blood zinc level and weight, length and head circumference at birth.

DESCRIPTIVE STATISTICS

TABLE - 8 ANTHROPOMETRY AT BIRTH - AGA Vs SGA

	AGA			SGA		
	WT(kg)	**LEN(cm)**	**HC(cm)**	**WT(kg)**	**LEN(cm)**	**HC(cm)**
MEAN	3.128	49.06	36.07	2.1168	49.014	36.02
SD	0.346	1.854	0.557	0.183	1.388	1.020
MIN	2.65	46.4	34.6	1.81	46.5	33.7
MAX	3.71	52.5	36.8	2.42	52.1	37.8

TABLE - 9 STUDENT T TEST

	P VALUE	**SIGNIFICANCE**
WT	0.000	SIGNIFICANT
LEN	0.874	NOT SIGNIFICANT
HC	0.762	NOTSIGNIFICANT

Table 8 shows that the mean birth weight of the appropriate for gestational age babies was 3.128 kg and the mean birth weight of the small for gestational babies was 2.116 kg. The mean length at birth in appropriate for

gestational age babies was 49.06 cm and the mean length in small for gestational babies was 49.01 cm. The mean head circumference at birth in appropriate for gestational age babies was 36.07 cm and the mean head circumference at birth in small for gestational babies was 36.02 cm.

There was no significant difference in the length and head circumference at birth in both appropriate for gestational age babies and small for gestational age babies.

DESCRIPTIVE STATISTICS

TABLE – 9 : ANTHROPOMETRY AT 7 DAYS -AGA Vs SGA

	AGA			SGA		
	WT(kg)	**LEN(cm)**	**HC(cm)**	**WT(kg)**	**LEN(cm)**	**HC(cm)**
MEAN	3.106	49.80	36.548	2.127	49.936	35.856
SD	0.344	1.812	0.553	0.204	1.189	0.762
MIN	2.60	47	35	1.75	48	34.5
MAX	3.65	53	37.2	2.5	52.8	37.4

TABLE – 10 : STUDENT T TEST

	P VALUE	**SIGNIFICANCE**
WT	0.000	SIGNIFICANT
LEN	0.663	NOT SIGNIFICANT
HC	0.000	SIGNIFICANT

The above tabulation shows that the weight and head circumference in small for gestational age were significantly lower than the appropriate for gestational age at 7 days. There was no significant difference in length between AGA and SGA babies at 7 days.

DESCRIPTIVE STATISTICS

TABLE - 11 ANTHROPOMETRY AT 14 DAYS - AGA Vs SGA

	AGA			SGA		
	WT(kg)	**LEN(cm)**	**HC(cm)**	**WT(kg)**	**LEN(cm)**	**HC(cm)**
MEAN	3.221	50.362	37.026	2.3122	50.722	36.314
SD	0.338	2.449	0.535	0.182	1.164	0.757
MIN	2.71	38.4	35.5	1.98	48.6	34.9
MAX	3.80	53.7	37.7	2.65	53.5	37.8

TABLE - 12 STUDENT T TEST

	P VALUE	**SIGNIFICANCE**
WT	0.000	SIGNIFICANT
LEN	0.350	NOT SIGNIFICANT
HC	0.000	SIGNIFICANT

The above tabulation shows that the weight and head circumference in small for gestational age were significantly lower than the appropriate for gestational age at 14 days. There was no significant difference in length between AGA and SGA babies at 14 days.

DESCRIPTIVE STATISTICS

TABLE - 13 : ANTHROPOMETRY AT 21 DAYS-AGA Vs SGA

	AGA			SGA		
	WT(kg)	**LEN(cm)**	**HC(cm)**	**WT(kg)**	**LEN(cm)**	**HC(cm)**
MEAN	3.461	51.36	51.36	2.534	51.52	36.78
SD	0.330	1.696	1.696	0.193	1.124	0.746
MIN	2.93	49	49	2.00	49	35
MAX	4.01	55	55	2.86	54	38

TABLE - 14 : STUDENT T TEST

	P VALUE	**SIGNIFICANCE**
WT	0.000	SIGNIFICANT
LEN	0.570	NOT SIGNIFICANT
HC	0.000	SIGNIFICANT

The above tabulation shows that the weight and head circumference in small for gestational age babies were significantly lower than the appropriate for gestational age at 21 days. There was no significant difference in length between AGA and SGA babies at 21 days.

DESCRIPTIVE STATISTICS

TABLE – 15 : ANTHROPOMETRY AT 28 DAYS - AGA Vs SGA

	AGA			SGA		
	WT(kg)	**LEN(cm)**	**HC(cm)**	**WT(kg)**	**LEN(cm)**	**HC(cm)**
MEAN	3.708	52.138	37.964	2.786	52.326	37.272
SD	0.326	1.619	0.507	0.226	1.093	0.727
MIN	3.24	49.2	36.5	2.21	50.2	35.9
MAX	4.21	55.1	38.7	3.25	54.7	38.6

TABLE – 16 STUDENT T TEST

	P VALUE	SIGNIFICANCE
WT	0.000	SIGNIFICANT
LEN	0.498	NOT SIGNIFICANT
HC	0.000	SIGNIFICANT

The above tabulation shows that the weight and head circumference in small for gestational age were significantly lower than the appropriate for gestational age at 28 days. There was no significant difference in length between AGA and SGA babies at 28 days.

TABLE – 17 :ZINC Vs MATERNAL AGE IN SGA

	AGE (YEARS)					
ZINC (MICROG/DECILITRE)		**<20**	**21-25**	**26-30**	**>30**	**TOTAL**
	55-65	0	1	1	1	3
	65.1-80	2	1	3	1	7
	80.1-95	3	8	4	3	18
	95.1-110	3	9	4	1	17
	110.1-125	0	2	1	0	3
	125.1-140	1	0	0	0	1
	>140	0	1	0	0	1
		9	**22**	**13**	**16**	**50**

P VALUE-0.796 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and maternal age in SGA babies.

TABLE - 18 ZINC Vs PARITY OF THE MOTHER IN SGA

		PARITY		
ZINC (MICROG/DECILITRE)		**PRIMI**	**MULTI**	**TOTAL**
	55-65	2	1	3
	65.1-80	6	1	7
	80.1-95	7	11	18
	95.1-110	9	8	17
	110.1-125	2	1	3
	125.1-140	1	0	1
	>140	0	1	1
		27	**23**	**50**

PEARSON CHI SQUARE TEST

P VALUE-0.329 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and parity of the mother in small for gestational age babies.

TABLE – 19 ZINC Vs MODE OF DELIVERY IN SGA

		MODE OF DELIVERY		
ZINC (MICROG/DECILITRE)		**LN**	**LSCS**	**TOTAL**
	55-65	2	1	3
	65.1-80	4	3	7
	80.1-95	8	10	18
	95.1-110	11	6	17
	110.1-125	0	3	3
	125.1-140	1	0	1
	>140	1	0	1
		27	**23**	**50**

PEARSON CHI SQUARE TEST

P VALUE-0.331 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and mode of delivery in small for gestational age babies.

TABLE – 20 : ZINC Vs GESTATIONAL AGE IN SGA

		GESTATIONAL AGE			
ZINC (MICROG/DECILITRE)		**38 WEEKS**	**38-40 WEEKS**	**40 WEEKS**	**TOTAL**
	55-65	0	3	0	3
	65.1-80	3	4	0	7
	80.1-95	6	7	5	18
	95.1-110	10	6	1	17
	110.1-125	2	1	0	3
	125.1-140	0	1	0	1
	>140	0	1	0	1
		21	**23**	**6**	**50**

PEARSON CHI SQUARE TEST

P VALUE-0.291 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and gestational age in small for gestational age babies.

TABLE - 21 : ZINC Vs SEX OF THE BABY IN SGA

		SEX OF THE BABY		
ZINC (MICROG/DECILITRE)		**MALE**	**FEMALE**	**TOTAL**
	55-65	2	1	3
	65.1-80	5	2	7
	80.1-95	7	11	18
	95.1-110	8	9	17
	110.1-125	2	1	3
	125.1-140	0	1	1
	>140	0	1	1
		24	**26**	**50**

PEARSON CHI SQUARE TEST

P VALUE-0.566 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and sex in small for gestational age babies.

TABLE - 22 : ZINC Vs PONDERAL INDEX IN SGA

		PONDERAL INDEX		
ZINC (MICROG/DECILITRE)		**1.6-1.7**	**1.8-1.9**	
	55-65	1	2	3
	65.1-80	4	3	7
	80.1-95	8	10	18
	95.1-110	7	10	17
	110.1-125	1	2	3
	125.1-140	1	0	1
	>140	0	1	1
		27	**23**	**50**

PEARSON CHI SQUARE TEST

VALUE-0.823 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and Ponderal index in small for gestational age babies.

TABLE – 23 ZINC Vs MATERNAL AGE IN AGA

	AGE (YEARS)					
ZINC (MICROG/DECILITRE)		**<20**	**21-25**	**26-30**	**>30**	**TOTAL**
	55-65	0	0	0	0	0
	65.1-80	0	0	0	0	0
	80.1-95	1	11	7	1	20
	95.1-110	3	14	12	0	29
	110.1-125	0	0	0	0	0
	125.1-140	0	0	0	0	0
	>140	1	0	0	0	1
		5	**25**	**19**	**1**	**50**

P VALUE=0.081 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and maternal age in appropriate for gestational age babies.

TABLE - 24 ZINC VS PARITY OF THE MOTHER IN AGA

		PARITY		
ZINC (MICROGRAM/DECILITRE)		**PRIMI**	**MULTI**	**TOTAL**
	55-65	0	0	0
	65.1-80	0	0	0
	80.1-95	10	10	20
	95.1-110	11	18	28
	110.1-125	0	0	0
	125.1-140	0	0	0
	>140	1	0	1
		22	**28**	**50**

PEARSON CHI SQUARE TEST

P VALUE=0.368 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and parity in appropriate for gestational age babies.

TABLE - 25 ZINC Vs MODE OF DELIVERY IN AGA

		MODE OF DELIVERY		
ZINC (MICROGRAM/DECILITRE)		**LN**	**LSCS**	**TOTAL**
	55-65	0	0	0
	65.1-80	0	0	0
	80.1-95	11	9	20
	95.1-110	14	15	29
	110.1-125	0	0	0
	125.1-140	0	0	0
	>140	1	0	1
		26	**24**	**50**

PEARSON CHI SQUARE TEST

P VALUE=0.561 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and mode of delivery in appropriate for gestational age babies.

TABLE - 26 : ZINC VS SEX OF THE BABY IN AGA

		SEX OF THE BABY		
ZINC (MICROGRAM/DECILITRE)		**MALE**	**FEMALE**	**TOTAL**
	55-65	0	0	0
	65.1-80	0	0	0
	80.1-95	9	11	20
	95.1-110	20	9	29
	110.1-125	0	0	0
	125.1-140	0	0	0
	>140	1	0	1
		30	**20**	**50**

PEARSON CHI SQUARE TEST

P VALUE=0.173 **NOT SIGNIFICANT**

The above tabulation shows that there was no significance between zinc and sex of the baby in appropriate for gestational age babies.

DISCUSSION

Infant mortality rate of India is 48 per 1000 live births which is mainly contributed by the high neonatal mortality rate of 32 per 1000 live births[1]. India contributes around 25% of world's neonatal deaths[8]. Thus one fourth of the world's total neonatal deaths occur in India.

In 2008, around 75% of the deaths in children less than 5 years occurred in 18 countries, out of this 40% occurred in three countries- Nigeria, India and Democratic republic of Congo[8]. Around 18 million babies are born as low birth weight in the world [8]. Low birth weight including preterm accounts for around 60-80% of the total neonatal deaths. Fifty percentage of these babies are born in South Asia[8]. Incidence of low birth weight in India is 28% [1].The incidence of low birth weight in sub-Saharan Africa is around 14% which is lower than ours. Thus efforts are on the way to reduce the incidence of low birth weight in India.

One of the most important causes of low birth weight in India is maternal malnutrition. While a lot of importance is being given to protein and energy deficits, micronutrients other than iron are often forgotten. Though they are needed only in small quantity, they have several vital functions in our human body. As their requirements are small, their adequacy have to be checked carefully and moreover many of the trace

elements have interactions with each other. Thus their needs have to be adequately met with a concern over their interactions and toxicity.

Among the several micronutrients, Iron stands first whose importance have been extensively studied and practised. Next lies zinc whose importance is slowly brought in to light by several research trials and studies.

Term-small for gestational age babies are more common than preterm babies in our country. Thus the role of zinc in term –small for gestational age babies have to be studied.

In this study, cord blood zinc level of fifty term appropriate for gestational age babies and fifty term small for gestational age babies have been analysed .The maternal and neonatal parameters of both the groups have been analysed. Further, the association between zinc and the other parameters have also been analysed in both the groups.

The aim was to study the association between zinc and birth weight in term small for gestational age babies and if low, whether low zinc level could be a cause for low birth weight in term small for gestational age babies. As there are multiple causes for low birth weight, many factors leading to low birth weight have been excluded.

In this study, the mean cord blood zinc level in term appropriate for gestational age babies was 97.074 micrograms/decilitre and the mean cord blood zinc level in term small for gestational age babies was 92.472 micrograms/decilitre. There was no statistically significant difference in zinc level between both the groups.

In a study by Elizabeth et al[10], the mean zinc level was 70.25 $\pm$ 24.59 micrograms/decliltre in term appropriate for gestational age babies and 78.09 $\pm$ 18.39 micrograms /decilitre in small for gestational age babies. Thus in our study the mean zinc level in both small for gestational age and appropriate for gestational age babies were higher than the above study.

However mean zinc value in appropriate for gestational age babies in our study was lower when compared with the studies done by Frkovic et al[25] (118$\pm$0.21 microgram/dl), Croatia and Awadallah et al[16] (114$\pm$23 microgram/dl), Jordan.

Zinc level in our study was comparable with the study done by Meadows et al[11], (94 micrograms/dl in appropriate for gestational age and 91 micrograms/dl in SGA), London.

According to a study by Iqbal et al[15] from Bangladesh, the mean zinc level in the group weighing from 2600 grams to 3000 grams was 83+/-0.43 micrograms /dl and in group of babies ranging from 37-39 weeks was 79 micrograms/dl.

In our study both the appropriate for gestational age and small for gestational age groups were comparable in the qualitative data like parity of the mother ($p>0.05$), mode of delivery ($p>0.05$) and the sex of the baby ($p>0.05$).

There was no significance in maternal age between both the groups. ($p>0.05$). The mean age of the mothers in appropriate for gestational age group was 24.56 and in SGA group was 24.96.

There was a weak positive correlation between the serum zinc level and the anthropometric parameters at birth (weight, length and head circumference) in both the groups but there was no statistical significance between the zinc level and anthropometric parameters at birth.

Thus there was no statistical significance between birth weight and zinc levels. This is in accordance with the Indian studies done by Srivastava et al[12], George et al[23], Chitra Upadhyaya et al[33]. The same inference was obtained in studies of other countries too. Meadows et al[11], Islam et al[13], Lao

et al[14], Iqbal et al[15], Watanabe et al[18], Doszpod et al[24], Bro s et al[28] and several other studies.

The results obtained in this study also agrees with several randomised controlled trials of maternal zinc supplementation and their effect on the birth weight. Most of these trials have concluded that maternal zinc supplementation did not have a significant effect on the birth weight of the babies. (Osendarp et al [38], Caulfield et al[39]).

But the trial done by Goldenberg et al[40] is contradictory to our study results. This trial concluded that the mean birth weight increased in mothers who were supplemented with zinc. Results obtained in the studies done by Elizabeth et al, Jeswani et al also contradict our study results, low zinc level was associated with low birth weight in these studies.

In this study, the mean birth weight of the appropriate for gestational age babies was 3.128kg and the mean birth weight of the small for gestational age babies was 2.116 kg. There was no significant difference in the length and head circumference at birth in both appropriate for gestational age and small for gestational age groups.

The weight gain and the increase in the head circumference of the small for gestational babies were significantly lower than the appropriate for gestational age babies at all four weeks of follow up. There was no significant difference in the increase in the length of the babies in both the groups at all four weeks of follow up.

In this study there was no significance between the serum zinc level and the maternal age, parity, mode of delivery and the sex of the baby in both appropriate for gestational age and small for gestational age groups.

CONCLUSION

- This study concludes that there is no statistical significance in the cord blood zinc level between the term-appropriate for gestational age babies and the term –small for gestational age babies.

- Cord blood zinc level has no significance with the birth weight of the baby.

- Thus we conclude that zinc deficiency alone cannot contribute to low birth weight.

- Further studies are needed to assess the role of zinc and other trace elements in neonates as zinc may affect the bioavailability of other trace elements.

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PROFORMA

1. Name
2. Age
3. IP No.
4. Address
5. Phone no.
6. Last menstrual period
7. Expected date of delivery
8. Details of admission
9. Marital history
10. Obstetric history
11. Past history-chronic illness, drug intake
12. Maternal height
13. Maternal weight
14. Body mass index
15. Blood group
16. Hemoglobin
17. HIV

    VDRL

    HBsAg

18. Details of delivery :labour naturale /caesarean section

19. Baby details.

    Birth weight

    Length

    Head circumference

    Ponderal index

    Gestational age

    Classification according to Lubchenco chart-AGA/SGA/LGA

    Sex of the baby

    Disc no.

    Apgar

    Any congenital anomaly

    Dysmorphic features

    Systemic examination

20. Cord blood zinc level

21. At 7 days-weight

    length

    head circumference

22.At 14 days- weight

length

head circumference

23.At 21 days- weight

length

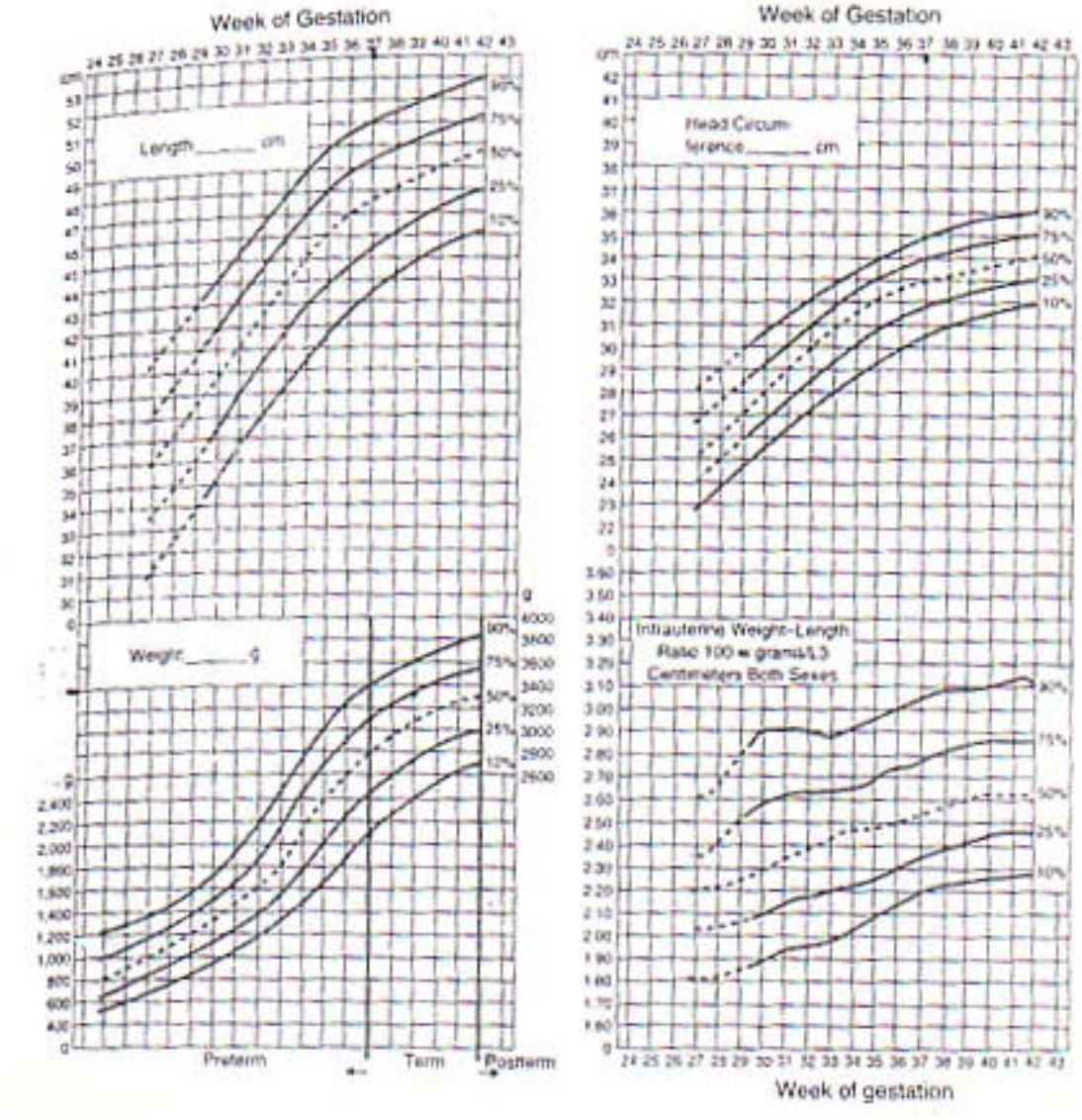
head circumference

24. At 28 days - weight

length

head circumference

LUBCHENCO INTRA UTERINE GROWTH CHART



LIST OF ABBREVIATIONS

AGA	-	Appropriate for gestational age
SGA	-	Small for gestational age
IUGR	-	Intrauterine growth retardation
TORCH	-	Toxoplasmosis, Rubella, Cytomegalovirus, Herpes, HIV.
WT	-	weight
LEN	-	length
HC	-	head circumference
LN	-	labour naturale
LSCS	-	lower segment caesarean section
PRIMI	-	primi para
MULTI	-	multi para
Cm	-	centimetre
kg	-	kilogram
dl	-	decilitre

Ethical Committee Certificate

ETHICAL COMMITTEE
GOVT. KILPAUK MEDICAL COLLEGE, KILPAUK,
CHENNAI- 10.
Venue: PANAGAL HALL, KMC
Dt: 01.02.2011

CHAIRPERSON
Prof. Dr.V.KANAGASABAI, MD.,
Dean
Govt. Kilpauk Medical College, Chennai-10
Sub: Ethical Committee project work - approved – regarding.
Ref: Lr.No.3944/Audit/E1/09 Dt. 30.11.2010

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With above reference, the Institutional Ethical committee meeting for the following students was conducted at our Institution on 01.02.2011.

S.NO.	Name	Topic
1.	Dr.Navin Kumar, MS(Ortho), PG., Govt. Royapettah Hospital, Chennai.	1.To Identify a Safe Zone to approach proximal Humerus 2.To study Anatomical relations of Axillary nerve, its course & its Variations
2.	Dr.T.Satheesh Kumar, D.Ortho., PG., Govt. Royapettah Hospital, Chennai	Heriditary Multiple Exostosis
3.	Dr.J. Jeya Shambavi, MD(Pathology), PG., Govt. Kilpauk Medical College, Chennai-10	Clinicopathological Histomorphological and Immunohistochemical Study of Neuroendocrine Tumors of GIT
4.	Dr.L. R. Saranya. MD., (Paed.)PG., Govt. Kilpauk Medical College, Chennai-10	Cord Blood Zinc Level in Term-Small for Gestational Age Neonates
5.	Dr.A.Satheesh Kumar, MS(ENT), PG., Kilpauk Medical College, Chennai	Study on Cases of Chronic Suppurative Otitis Media in Tubo Tympanic Type Due to Sinusitis as Focal Sepsis
6.	R.Prathiban,(Msc.,Physiology), PG., Student, The TN. Dr.MGR Medical University,Chennai-32	Prevalence of Cardiac Dysautonomia in Type I Diabetes mellitus
7.	B. Manikandan, (Msc., Physiology), PG., Student, The TN Dr.M.G.R. Medical University, Chennai-32.	A Comparative Study of Left Ventricular Structure and Function in Obese and Non Obese Subjects
8.	G. Selvakumar, (MSc., Physiology), PG., Student, The TN Dr.M.G.R. Medical University, Chennai-32.	A Study of the Intraocular Pressure In Patients with Diabetic Normotensive, Diabetic Hypertensive and Normal Subjects

9.	R. Ragulji, (Msc.,Physiology), PG., The TN Dr.MGR Medical University, Chennai-32.	A Study of Pulmonary function in insulin dependent diabetes mellitus
10.	V.M. Jenila Veny,(MscPhysiology), PG. The TN Dr.MGR Medical University, Chennai-32	Cardiovascular Autonomic Dysfunction in Chronic Kidney Disease
11.	Dr.G. Lakshmi, MD(O&G), PG., Govt. Kilpauk Medical College,Chennai-10	A Study of Association of Thyroid Disorders in Abnormal Uterine Bleeding
12.	Dr.R. Harini, MD(O&G), PG., Kilpauk Medical College, Chennai	Single Dose Antibacterial treatment for Asymptomatic Bacteriuria in Pregnancy
13.	Dr.E.Geetha, MD(O&G), PG., Govt. Kilpauk Medical College, Chennai-10	A Study of the incidence course of Pregnancy and Pregnancy outcome in Obstetric Cholestasis and to evaluate the efficiency of UDCA in relieving the Symptoms and Improving the Perinatal outcome in these Patients
14.	Dr.S. Nithya, MD(O&G), PG., Govt. Kilpauk Medical College, Chennai-10	Prospective Study of Prevalence of diabetes Mellitus, Thyroid Dysfunction and Hyperprolactinemia in Recurrent Pregnancy loss
15.	Dr.Mohideen Fathima, MD(O&G), PG., Govt. Kilpauk Medical College, Chennai-10	A Study of evaluation of multi system changes in Gestational hypertension / severe pre-eclamptic/eclampasia patients
16.	Dr.M.Padma Priya, MD(O&G), PG., Kilpauk Medical College, Chennai	Dyslipidemia as a Predictor of PIH
17.	Mrs.G. Savitha, (Msc.,Medical Bio Chemistry), TN Dr.M.G.R.Medical University, Chennai-32.	Association of subclinical hypothyroidism in metabolic syndrome patients
18.	Dr.K. Bharadhwaj, MD(G.M.), PG., Kilpauk Medical College, Ch-10	A Study on Peripheral Vascular Disease in Type 2 Diabetes Mellitus
19.	Dr.B.Priya, MD(G.M.), PG	Study of Serum Bilirubin Concentration in Established Coronary Artery Disease
20.	Dr.R.Hema, MD(G.M.), PG.,	Study of Troponin I level in Supraventricular Tachycardia in Non Cad Patients
21.	Dr.P.Manoj Kumar, MD(G.M.), PG., Kilpauk Medical College, Ch-10	A Study on Pulmonary Functions in Type 2 Diabetes Mellitus
22.	Dr.M.Dhanasekar, MD(G.M.), PG.,	Prognostic Risk Stratification of Acute Coronary Syndrome – Role of Highly Sencitive – Reactive Protien
23.	Dr.N. Karthik, MD(G.M.), PG., Govt.Kilpauk Medical College, Chennai-10	A Study of Comparison of QT Dispersion in Acute Myocardial Infraction Between Early Reperfusion and Late Reperfusion Therapy

24.	Dr.H. Anuradha, MD(G.M.), PG., Kilpauk Medical College, Ch-10	A Study of Stress Hyperglycemia in Moderate Degree Burns
25	Dr. V. Nandakumar, MD(G.M.), PG.,	A Prospective Study of Clinical Profile of Emphysematous Pyelonephritis in Type Two Diabetes Mellitus
26.	Dr.S.Sasikumar, MS(G.S.), PG., Govt. Royapettah Hospital, Chennai	A Study of Unusual Presentations of Appendicitis.
27.	Dr.S.R.Padmanabhan, MS(GS), PG., Govt. Royapettah Hospital, Chennai	A Comparative Study Between Autologous Platelet Rich Plasma and Saline Dressing for Diabetic Ulcer
28.	Dr.C.Rose, Scientist-G and Head, Biotechnology, Central Leather Institute, Chennai.	Wound healing efficacy of the chitosan – containing collagenous biomaterial, on burn wound
29.	E.K. Lavanya,B.Tech, Biotechnology, PG., Prathyusha Institute of Technology and Management, Tiruvallur.	Isolation and Characterization of Bacterial Pathogens from Eye Infection

We are glad to inform you that at the Ethical Committee meeting, the documents were discussed and the above short term projects are Ethically approved.

4/2/11
CHAIRPERSON
. DEAN
Govt. Kilpauk Medical College,
Chennai-10.

To: The Individuals

CONSENT FORM

ஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு

நிறைமாத குறைந்த எடை பச்சிளங் குழந்தைகளின் தொப்புள்கொடி ரத்தத்தில் ஜிங்கின் (துத்தநாகம்) அளவு

குழந்தைகள் மற்றும் பச்சிளங் குழந்தைகள் நலத்துறை

கீழப்பாக்கம் மருத்துவக் கல்லூரி மற்றும் மருத்துவமனை

சென்னை-10. :

பங்கு பெறுபவரின் பெயர் :
பங்கு பெறுபவரின் வயது :
பங்கு பெறுபவரின் எண் :
குழந்தையின் விவரம் - ஆண்/ பெண் :
எடை :

பங்கு பெறுபவர் இதனை (√) குறிக்கவும்.

- மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய சந்தேகங்களை கேட்கவும் அதற்கான தகுந்த விளக்கங்களை கேட்க வாய்ப்பளிக்கப்பட்டுள்ளது என அறிந்து கொண்டேன். ☐

- நானும், என் குழந்தையும் பங்கேற்க சம்மதிக்கிறேன். இது யாருடைய வற்புறுத்தலுமின்றி தன்னிச்சையாக கூறும் முடிவு, எந்த காரணத்தினாலோ எந்த சட்டசிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக் கொள்ளலாம் என்றும் அறிந்து கொண்டேன். ☐

- இந்த ஆய்வு சம்பந்தமாகவோ அதை சார்ந்து மேலும் ஆய்வு மேற்கொள்ளும் போதும் இந்த ஆய்வில் பங்கு பெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். ☐

- இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ முடிவையோ பயன்படுத்திக் கொள்ள மறுக்கமாட்டேன். ☐

- இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக் கொள்கிறேன். இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உன்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன். ☐

- இந்த ஆய்வில் ஒருமுறை 2.5 மி இரத்தம் தொப்புள் கொடியின் நஞ்சுப்பையின் முனையில் இருந்து பரிசோதனைக்காக எடுத்தக் கொள்ளப்படும் என்பதை அறிவேன்.

பங்கேற்பவரின் கையொப்பம்_____ இடம்_____
தேதி_____
பங்கேற்பவரின் பெயர் மற்றும் விலாசம்

சாட்சியாளரின் கையொப்பம்
இடம்_____ தேதி_____
சாட்சியாளரின் பெயர் மற்றும் விலாசம்
ஆய்வாளரின் கையொப்பம்
இடம்_____ தேதி_____
ஆய்வாளரின் பெயர்_____

KEY TO MASTER CHART

MOD	-	Mode of Delivery
WT _ 0	-	Birth Weight
LEN _0	-	Length at Birth
HC_0	-	Head Circumference at Birth
GEAGE_0	-	Gestational age
PI_0	-	Ponderal Index
LN	-	Labour Naturale
LSCS	-	Lower Segment Caesarean Section
WT_7	-	Weight at 7 Days
WT _14	-	Weight at 14 Days
WT_21	-	Weight at 21 Days
WT_28	-	Weight at 28 Days
LEN_7	-	Length at 7 Days
LEN_14	-	Length at 14 Days
LEN_21	-	Length at 21 Days
LEN_28	-	Length at 28 Days
HC_7	-	Head Circumference at 7 Days
HC_14	-	Head Circumference at 14 Days
HC_21	-	Head Circumference at 21 Days
HC_28	-	Head Circumference at 28 Days

MASTER CHART

TERM - SMALL FOR GESTATIONAL AGE BABIES

SL. No	NAME	AGE	PARITY	MOD	WT_0	LEN_0	HC_0	GEAGE_0	SEX	PI_0	ZINC_0
1	B/o MAHALAKSHMI	25	M	LN	2.29	50.2	35.6	38-40	FEMALE	1.8	140.4
2	B/o GEETHA SALIM	35	M	LN	2.41	50.2	36.2	40	FEMALE	1.9	87.0
3	B/o MADHAVI	20	P	LN	2.25	50.9	37.1	38-40	FEMALE	1.7	94.5
4	B/o SUMATHY	25	M	LSCS	1.81	46.5	34.6	38	FEMALE	1.8	96.0
5	B/o SARALA	20	P	LSCS	2.11	49.8	35.5	38	MALE	1.7	75.4
6	B/o USHA	27	M	LSCS	2.33	49.1	36.9	38-40	MALE	1.9	91.9
7	B/o MAHALAKSHMI	32	M	LN	2.31	50.4	37.5	38-40	FEMALE	1.8	102.3
8	B/o LATHA	25	M	LSCS	2.01	49.0	36.3	38	FEMALE	1.7	89.2
9	B/o JEYALAKSHMI	19	P	LN	2.25	50.9	35.2	38-40	FEMALE	1.7	128.4
10	B/o THAVAMANI	20	P	LSCS	2.00	50.0	37.5	38	FEMALE	1.6	91.0
11	B/o GEETHA KUMAR	36	P	LN	2.42	51.2	37.5	40	MALE	1.8	91.8
12	B/o SANTHANA MARI	25	M	LSCS	2.41	52.1	37.3	40	MALE	1.7	93.1
13	B/o VIJI	22	P	LSCS	2.40	50.1	36.9	40	FEMALE	1.9	101.3
14	B/o GANDHIMATHY	21	P	LSCS	2.36	49.3	36.1	40	MALE	1.9	85.8
15	B/o REVATHY	25	M	LSCS	2.34	51.6	37.8	38-40	MALE	1.7	84.8
16	B/o GANGA DEVI	24	M	LSCS	2.19	48.6	35.7	38-40	MALE	1.9	87.7
17	B/o SEETHA	22	P	LN	1.93	47.5	33.7	38	FEMALE	1.8	85.3
18	B/o NADHIYA	21	P	LN	1.92	48.3	34.1	38	FEMALE	1.7	96.0
19	B/o DEIVARATCHAGI	32	M	LSCS	2.22	48.7	35.7	38	FEMALE	1.9	86.0
20	B/o AARTHY	19	P	LN	1.83	47.3	36.5	38	FEMALE	1.7	95.8
21	B/o VEERASELVI	19	P	LSCS	2.04	49.3	36.7	38	MALE	1.7	79.7
22	B/o KAROLINE	20	M	LN	2.10	48.8	37.1	38-40	FEMALE	1.8	91.3
23	B/o CHITHRA	32	P	LSCS	2.12	49.9	35.8	38-40	FEMALE	1.7	78.8
24	B/o SUMITHRA	27	P	LN	2.11	48.0	35.6	38-40	FEMALE	1.9	73.4
25	B/o SANKARI	25	P	LN	1.82	46.5	34.6	38-40	MALE	1.8	70.4
26	B/o SANDHYA	26	M	LN	1.81	47.3	34.4	38	MALE	1.7	70.0
27	B/o NEELA VENI	24	M	LN	2.10	49.8	35.5	38-40	FEMALE	1.7	62.1
28	B/o JAYAMALINI	27	P	LN	1.92	47.4	35.0	38-40	MALE	1.8	72.1
29	B/o RADHIKA	29	P	LN	2.32	49.6	36.6	38-40	MALE	1.9	58.7
30	B/o ARCHANA	31	P	LSCS	2.17	48.5	37.1	38-40	MALE	1.9	61.1
31	B/o MANGAI	26	M	LSCS	2.05	48.4	36.1	38	FEMALE	1.8	91.6
32	B/o DEVI	25	P	LN	1.83	47.5	36.6	38-40	FEMALE	1.7	82.5
33	B/o JEYA	20	M	LSCS	2.09	49.7	37.0	38-40	MALE	1.7	98.1
34	B/o GOWTHAMI	21	P	LN	2.10	49.8	36.3	38-40	MALE	1.7	101.2
35	B/o SEETHA	22	M	LN	2.08	48.2	35.1	38	FEMALE	1.8	98.2
36	B/o SENTHAMARAI	28	M	LSCS	1.81	46.5	34.2	38	FEMALE	1.8	99.0
37	B/o RUBINI	29	P	LSCS	2.23	49.8	35.6	38	MALE	1.8	101.4
38	B/o GEETHA	30	M	LSCS	2.26	46.8	36.6	38-40	MALE	1.7	85.6
39	B/o TAMILARASI	24	P	LN	2.41	49.9	37.5	40	FEMALE	1.9	91.7
40	B/o RAMYA	26	M	LN	1.88	47.9	35.5	38	FEMALE	1.7	102.6
41	B/o SATHYA	20	P	LN	2.07	47.7	36.6	38-40	MALE	1.9	104.3
42	B/o SOUNDARYA	29	M	LSCS	2.08	48.7	35.5	38	FEMALE	1.8	111.7
43	B/o KAMALA	25	P	LN	2.11	49.8	36.4	38	MALE	1.7	102.4
44	B/o SELVI	27	M	LN	1.97	47.8	36.0	38	MALE	1.8	103.1
45	B/o DEVI	23	P	LSCS	2.13	50.0	36.7	38	MALE	1.7	124.1
46	B/o AMUDHA	21	P	LSCS	2.06	48.5	35.3	38-40	MALE	1.8	111.2
47	B/o VALARMATHY	28	M	LN	1.84	47.6	34.1	38	FEMALE	1.7	92.6
48	B/o VENNILA	23	M	LN	2.23	49.8	35.6	38	FEMALE	1.8	95.6
49	B/o JEYANTHI	21	P	LN	2.15	48.3	36.7	38-40	MALE	1.9	106.3
50	B/o SUMATHY	25	P	LSCS	2.16	51.2	35.5	38-40	MALE	1.6	99.1

TERM - APPROPRIATE FOR GESTATIONAL AGE BABIES

SL. No	NAME	AGE	PARITY	MOD	WT_0	LEN_0	HC_0	GEAGE_0	SEX	ZINC_0
1	B/o STELLA	28	M	LSCS	3.41	51.2	36.6	38-40	MALE	95.4
2	B/o VIJAYALAKSHMI	28	M	LSCS	3.32	50.2	36.4	38-40	MALE	106.2
3	B/o NALINI	28	M	LSCS	3.08	48.6	35.6	38-40	MALE	102.8
4	B/o SARASWATHY	23	M	LSCS	3.71	52.4	35.5	38-40	FEMALE	104.2
5	B/o BHUVANESHWARI	22	P	LN	2.92	48.0	36.5	38-40	MALE	108.2
6	B/o PRIYA	20	P	LSCS	2.75	47.1	36.5	38-40	MALE	101.5
7	B/o DHANALAKSHMI	23	M	LN	3.32	50.1	35.7	38-40	FEMALE	99.2
8	B/o PRAMILA	21	P	LN	3.60	52.1	36.7	38-40	FEMALE	100.3
9	B/o RAMANI	19	P	LN	2.86	47.6	36.8	38-40	MAL E	140.8
10	B/o PREMA	30	P	LSCS	2.83	46.4	36.2	38-40	FEMALE	102.2
11	B/o KANCHANA	22	P	LSCS	3.61	51.5	36.8	38-40	FEMALE	96.2
12	B/o SANGEETHA	24	M	LN	2.75	47.1	35.9	38-40	MALE	93.4
13	B/o VISALATCHI	26	M	LSCS	2.80	47.6	35.6	38-40	MALE	105.3
14	B/o VIJAYALAKSHMI	22	P	LN	3.01	48.7	34.6	38-40	MALE	101.3
15	B/o AGASTHIA	21	P	LSCS	3.23	48.8	36.6	38-40	FEMALE	85.3
16	B/o SURYA	23	P	LN	2.74	47.0	36.4	38-40	MALE	99.1
17	B/o DEEPA	24	M	LN	3.60	51.6	36.1	38-40	FEMALE	101.1
18	B/o SARANYA	22	M	LN	2.65	46.5	35.6	38-40	MALE	98.6
19	B/o DEVI	28	M	LSCS	2.81	47.1	36.5	38-40	MALE	97.2
20	B/o ELLAMMMA	32	P	LN	3.41	50.6	35.3	38-40	MALE	93.4
21	B/o RAASATHI	19	P	LSCS	2.68	47.1	36.5	38-40	FEMALE	92.5
22	B/o VAIDEGI	23	P	LN	2.92	48.8	36.2	38-40	MALE	93.2
23	B/o SAVITHRI	30	P	LN	2.93	48.1	36.5	38-40	MALE	101.4
24	B/o FARHANA	19	P	LN	2.74	47.2	36.5	38-40	FEMALE	99.2
25	B/o AMMANI	29	M	LN	3.70	51.4	36.5	38-40	MALE	99.6
26	B/o KAVITHA	29	M	LN	2.89	48.0	36.5	38-40	MALE	95.2
27	B/o PREETHA	27	P	LSCS	3.49	51.2	35.8	38-40	FEMALE	93.6
28	B/o SUMATHY	28	M	LSCS	2.89	47.1	36.6	38-40	FEMALE	92.4
29	B/o DEEPA	26	P	LN	2.76	47.1	36.5	38-40	MALE	94.3
30	B/o KAVITHA	27	M	LSCS	3.65	52.1	35.4	38-40	FEMALE	94.2
31	B/o DEVI	23	P	LSCS	2.84	48.2	35.9	38-40	MALE	96.5
32	B/o SARANYA	20	P	LN	3.21	50.1	35.6	38-40	FEMALE	100.1
33	B/o SANGEETHA	29	M	LSCS	3.49	51.0	36.7	38-40	MALE	95.2
34	B/o RAMYA	22	M	LN	3.58	51.5	35.4	38-40	MALE	98.4
35	B/o REVATHY	21	M	LSCS	3.02	48.6	35.6	38-40	MALE	97.5
36	B/o SEETHA	30	M	LSCS	3.11	48.7	36.5	38-40	FEMALE	96.4
37	B/o NADHIYA	24	M	LSCS	3.42	50.0	35.2	38-40	MALE	95.2
38	B/o USHA	28	M	LN	2.92	47.9	35.0	38-40	MALE	85.9
39	B/o SUMATHY	23	P	LN	2.83	47.0	34.9	38-40	FEMALE	89.2
40	B/o LATHA	21	M	LSCS	2.74	47.1	35.6	38-40	MALE	96.4
41	B/o LAKSHMI	25	M	LSCS	3.14	48.7	36.2	38-40	FEMALE	89.3
42	B/o SHALINI	26	M	LN	3.52	51.1	36.7	38-40	MALE	98.2
43	B/o KAMALA	24	M	LN	3.68	52.5	36.3	38-40	FEMALE	91.6
44	B/o REVATHY	23	P	LSCS	3.04	48.4	35.7	38-40	MALE	92.3
45	B/o SARITHA	21	M	LN	2.78	47.2	36.3	38-40	FEMALE	89.6
46	B/o GEETHA	24	M	LN	2.89	48.1	35.7	38-40	FEMALE	91.5
47	B/o PRIYA	27	P	LSCS	3.63	49.5	36.6	38-40	MALE	93.4
48	B/o SARANYA	26	M	LN	3.24	50.6	35.7	38-40	FEMALE	91.2
49	B/o NADHIYA	25	M	LSCS	3.59	51.5	36.5	38-40	MALE	90.3
50	B/o LATHA	23	P	LN	2.71	47.3	36.5	38-40	MALE	88.2

TERM - SMALL FOR GESTATIONAL AGE BABIES - WEIGHT

SL. No	NAME	WT_7	WT_14	WT_21	WT_28
1	B/o MAHALAKSHMI	2.25	2.41	2.58	2.81
2	B/o GEETHA SALIM	2.36	2.42	2.65	2.90
3	B/o MADHAVI	2.20	2.51	2.76	3.10
4	B/o SUMATHY	1.75	2.01	2.21	2.55
5	B/o SARALA	2.10	2.31	2.54	2.81
6	B/o USHA	2.35	2.45	2.69	3.02
7	B/o MAHALAKSHMI	2.40	2.61	2.78	3.15
8	B/o LATHA	2.00	2.21	2.38	2.66
9	B/o JEYALAKSHMI	2.30	2.32	2.53	2.85
10	B/o THAVAMANI	1.90	2.20	2.37	2.56
11	B/o GEETHA KUMAR	2.45	2.59	2.82	3.14
12	B/o SANTHANA MARI	2.50	2.65	2.86	3.24
13	B/o VIJI	2.35	2.48	2.75	3.08
14	B/o GANDHIMATHY	2.40	2.45	2.74	3.11
15	B/o REVATHY	2.41	2.56	2.77	2.98
16	B/o GANGA DEVI	2.25	2.46	2.67	2.92
17	B/o SEETHA	1.90	2.11	2.32	2.53
18	B/o NADHIYA	1.89	2.16	2.36	2.63
19	B/o DEIVARATCHAGI	2.25	2.44	2.65	2.90
20	B/o AARTHY	1.80	1.98	2.21	2.46
21	B/o VEERASELVI	2.00	2.13	2.34	2.56
22	B/o KAROLINE	2.13	2.23	2.45	2.67
23	B/o CHITHRA	2.15	2.37	2.61	2.84
24	B/o SUMITHRA	2.16	2.36	2.58	2.81
25	B/o SANKARI	1.80	2.00	2.23	2.51
26	B/o SANDHYA	1.80	2.10	2.31	2.54
27	B/o NEELA VENI	2.15	2.36	2.57	2.71
28	B/o JAYAMALINI	1.89	2.00	2.34	2.62
29	B/o RADHIKA	2.20	2.41	2.61	2.73
30	B/o ARCHANA	2.20	2.31	2.51	2.76
31	B/o MANGAI	2.10	2.20	2.44	2.68
32	B/o DEVI	1.87	2.10	2.00	2.21
33	B/o JEYA	2.12	2.34	2.66	2.91
34	B/o GOWTHAMI	2.30	2.23	2.53	2.76
35	B/o SEETHA	2.12	2.23	2.54	2.84
36	B/o SENTHAMARAI	1.80	2.00	2.28	2.52
37	B/o RUBINI	2.25	2.42	2.65	2.86
38	B/o GEETHA	2.40	2.61	2.84	3.25
39	B/o TAMILARASI	2.40	2.61	2.82	3.15
40	B/o RAMYA	1.86	2.10	2.32	2.45
41	B/o SATHYA	2.00	2.21	2.42	2.66
42	B/o SOUNDARYA	2.10	2.34	2.55	2.71
43	B/o KAMALA	2.13	2.30	2.52	2.74
44	B/o SELVI	1.91	2.20	2.45	2.67
45	B/o DEVI	2.15	2.33	2.57	2.78
46	B/o AMUDHA	2.10	2.32	2.53	2.72
47	B/o VALARMATHY	1.82	2.10	2.34	2.54
48	B/o VENNILA	2.21	2.44	2.66	2.84
49	B/o JEYANTHI	2.20	2.42	2.64	2.87
50	B/o SUMATHY	2.25	2.51	2.75	3.01

TERM-APPROPRIATE FOR GESTATIONAL AGE BABIES-WEIGHT

SL. No	NAME	WT_7	WT_14	WT_21	WT_28
1	B/o STELLA	3.40	3.45	3.64	3.82
2	B/o VIJAYALAKSHMI	3.31	3.42	3.64	3.85
3	B/o NALINI	3.10	3.25	3.46	3.67
4	B/o SARASWATHY	3.65	3.80	4.01	4.18
5	B/o BHUVANESHWARI	2.90	3.00	3.18	3.41
6	B/o PRIYA	2.70	2.80	3.10	3.31
7	B/o DHANALAKSHMI	3.31	3.33	3.54	3.78
8	B/o PRAMILA	3.58	3.70	3.91	4.20
9	B/o RAMANI	2.86	3.00	3.24	3.45
10	B/o PREMA	2.80	3.00	3.24	3.46
11	B/o KANCHANA	3.57	3.70	3.91	4.19
12	B/o SANGEETHA	2.71	2.90	3.24	3.65
13	B/o VISALATCHI	2.75	2.92	3.23	3.48
14	B/o VIJAYALAKSHMI	3.45	3.52	3.74	3.96
15	B/o AGASTHIA	3.25	3.40	3.64	3.86
16	B/o SURYA	2.70	2.81	3.05	3.32
17	B/o DEEPA	3.55	3.71	3.96	4.21
18	B/o SARANYA	2.62	2.72	2.98	3.24
19	B/o DEVI	2.80	3.00	3.25	3.46
20	B/o ELLAMMMA	3.42	3.54	3.85	4.10
21	B/o RAASATHI	2.60	2.71	2.93	3.30
22	B/o VAIDEGI	2.90	3.02	3.27	3.58
23	B/o SAVITHRI	2.90	3.05	3.34	3.59
24	B/o FARHANA	2.73	2.90	3.23	3.45
25	B/o AMMANI	3.65	3.72	3.91	4.20
26	B/o KAVITHA	2.91	3.00	3.21	3.42
27	B/o PREETHA	3.42	3.53	3.79	3.99
28	B/o SUMATHY	2.85	3.02	3.23	3.62
29	B/o DEEPA	2.70	2.82	3.02	3.25
30	B/o KAVITHA	3.60	3.71	3.93	4.19
31	B/o DEVI	2.80	2.90	3.22	3.45
32	B/o SARANYA	3.19	3.26	3.47	3.68
33	B/o SANGEETHA	3.42	3.51	3.72	3.94
34	B/o RAMYA	3.52	3.61	3.84	4.10
35	B/o REVATHY	3.00	3.10	3.35	3.68
36	B/o SEETHA	3.10	3.21	3.52	3.73
37	B/o NADHIYA	3.40	3.51	3.73	3.95
38	B/o USHA	2.90	3.01	3.25	3.46
39	B/o SUMATHY	2.81	2.92	3.15	3.36
40	B/o LATHA	2.72	2.80	3.01	3.26
41	B/o LAKSHMI	3.10	3.21	3.52	3.76

42	B/o SHALINI	3.50	3.62	3.83	4.10
43	B/o KAMALA	3.60	3.71	3.91	4.18
44	B/o REVATHY	3.00	3.10	3.35	3.63
45	B/o SARITHA	2.72	2.81	3.00	3.26
46	B/o GEETHA	2.85	2.91	3.19	3.41
47	B/o PRIYA	3.60	3.72	3.96	4.20
48	B/o SARANYA	3.20	3.27	3.48	3.69
49	B/o NADHIYA	3.50	3.62	3.88	4.12
50	B/o LATHA	2.70	2.81	3.00	3.25

TERM - SMALL FOR GESTATIONAL AGE BABIES - LENGTH

SL. No	NAME	LEN_7	LEN_14	LEN_21	LEN_28
1	B/o MAHALAKSHMI	50.8	51.4	52	52.8
2	B/o GEETHA SALIM	50.7	51.5	52	53.2
3	B/o MADHAVI	51.6	52.3	53	54.1
4	B/o SUMATHY	49.1	50.2	51	51.9
5	B/o SARALA	50.6	51.5	52	53.1
6	B/o USHA	50.0	50.9	52	52.4
7	B/o MAHALAKSHMI	51.1	52.0	53	53.6
8	B/o LATHA	49.7	50.3	51	51.8
9	B/o JEYALAKSHMI	51.4	52.1	53	53.6
10	B/o THAVAMANI	50.7	51.2	52	52.8
11	B/o GEETHA KUMAR	51.7	52.4	53	53.8
12	B/o SANTHANA MARI	52.8	53.5	54	54.7
13	B/o VIJI	50.8	51.6	52	53.1
14	B/o GANDHIMATHY	50.1	51.0	52	52.6
15	B/o REVATHY	52.2	52.9	54	54.2
16	B/o GANGA DEVI	49.6	50.5	52	52.3
17	B/o SEETHA	48.2	48.7	49	50.4
18	B/o NADHIYA	49.1	50.4	51	52.1
19	B/o DEIVARATCHAGI	49.4	50.0	51	51.5
20	B/o AARTHY	48.0	48.6	50	50.4
21	B/o VEERASELVI	49.9	50.5	51	52.0
22	B/o KAROLINE	49.6	50.2	51	51.9
23	B/o CHITHRA	50.6	51.2	52	52.7
24	B/o SUMITHRA	48.6	49.5	50	51.2
25	B/o SANKARI	48.6	49.5	50	51.0
26	B/o SANDHYA	48.0	48.8	50	50.4
27	B/o NEELA VENI	50.3	51.0	52	52.1
28	B/o JAYAMALINI	48.0	48.7	50	50.2
29	B/o RADHIKA	50.2	51.0	52	52.4
30	B/o ARCHANA	49.2	50.0	51	51.7
31	B/o MANGAI	50.0	50.7	51	52.2
32	B/o DEVI	48.3	49.1	50	51.0
33	B/o JEYA	50.5	51.2	52	52.7
34	B/o GOWTHAMI	50.6	51.4	52	52.9
35	B/o SEETHA	49.0	49.8	51	51.3
36	B/o SENTHAMARAI	49.0	49.8	51	51.4
37	B/o RUBINI	50.4	51.2	52	52.8
38	B/o GEETHA	51.8	52.6	53	54.1
39	B/o TAMILARASI	50.6	51.3	52	53.0
40	B/o RAMYA	48.6	49.5	50	51.4
41	B/o SATHYA	48.7	49.8	51	51.7

42	B/o SOUNDARYA	49.6	50.6	52	52.5
43	B/o KAMALA	50.6	51.5	53	53.4
44	B/o SELVI	48.5	49.4	50	51.4
45	B/o DEVI	50.8	51.7	53	53.6
46	B/o AMUDHA	49.5	50.4	51	52.3
47	B/o VALARMATHY	48.4	49.1	50	50.8
48	B/o VENNILA	50.6	51.4	52	52.7
49	B/o JEYANTHI	49.1	50.0	51	51.5
50	B/o SUMATHY	51.6	52.2	53	53.6

TERM - APPROPRIATE FOR GESTATIONAL BABIES - LENGTH

SL. No	NAME	LEN_7	LEN_14	LEN_21	LEN_28
51	B/o STELLA	51.8	52.6	53	53.7
52	B/o VIJAYALAKSHMI	50.9	51.7	52	53.1
53	B/o NALINI	49.4	50.0	51	51.5
54	B/o SARASWATHY	53.0	53.5	54	54.9
55	B/o BHUVANESHWARI	48.7	49.6	51	51.2
56	B/o PRIYA	47.8	48.8	50	50.6
57	B/o DHANALAKSHMI	50.6	51.4	53	53.1
58	B/o PRAMILA	52.7	53.0	54	54.7
59	B/o RAMANI	48.5	49.3	50	51.2
60	B/o PREMA	47.0	47.8	49	49.2
61	B/o KANCHANA	52.2	53.0	54	54.2
62	B/o SANGEETHA	47.6	38.4	49	50.0
63	B/o VISALATCHI	48.4	49.0	50	50.6
64	B/o VIJAYALAKSHMI	49.6	50.5	52	52.4
65	B/o AGASTHIA	49.6	50.4	52	52.4
66	B/o SURYA	47.6	48.4	50	50.9
67	B/o DEEPA	52.0	52.7	54	54.0
68	B/o SARANYA	47.3	48.0	49	49.7
69	B/o DEVI	48.0	48.8	50	50.6
70	B/o ELLAMMMA	51.0	51.6	52	53.0
71	B/o RAASATHI	48.0	48.7	50	50.6
72	B/o VAIDEGI	49.6	50.4	51	52.1
73	B/o SAVITHRI	48.9	49.8	51	51.7
74	B/o FARHANA	48.0	48.9	50	50.7
75	B/o AMMANI	52.0	52.8	54	54.0
76	B/o KAVITHA	48.7	49.6	51	51.5
77	B/o PREETHA	51.9	52.6	54	54.0
78	B/o SUMATHY	47.7	48.4	49	49.7
79	B/o DEEPA	48.0	48.7	50	50.0
80	B/o KAVITHA	53.0	53.7	54	54.5
81	B/o DEVI	49.0	49.6	51	51.5
82	B/o SARANYA	50.7	51.5	53	53.4
83	B/o SANGEETHA	51.5	52.4	53	54.0
84	B/o RAMYA	52.0	52.6	53	53.6
85	B/o REVATHY	49.5	50.4	51	51.6
86	B/o SEETHA	49.6	50.5	52	52.4
87	B/o NADHIYA	50.5	51.5	52	53.4
88	B/o USHA	48.6	49.2	50	50.6
89	B/o SUMATHY	47.8	48.5	49	50.0
90	B/o LATHA	47.9	48.7	50	50.6
91	B/o LAKSHMI	49.5	50.4	51	52.2
92	B/o SHALINI	51.9	52.7	53	53.6
93	B/o KAMALA	53.0	53.6	55	55.1
94	B/o REVATHY	49.2	50.0	50	51.0

95	B/o SARITHA	47.9	48.7	50	50.6
96	B/o GEETHA	49.0	49.9	51	51.8
97	B/o PRIYA	52.0	52.6	53	54.2
98	B/o SARANYA	51.0	51.6	52	53.0
99	B/o NADHIYA	52.0	52.7	53	53.8
100	B/o LATHA	48.0	48.9	50	50.7

TERM - SMALL FOR GESTATIONAL AGE BABIES - HEAD CIRCUMFERENCE

SL. No	NAME	HC_7	HC_14	HC_21	HC_28
1	B/o MAHALAKSHMI	36.1	36.6	37	37.5
2	B/o GEETHA SALIM	36.5	37.0	38	38.1
3	B/o MADHAVI	37.1	37.5	38	38.6
4	B/o SUMATHY	35.1	35.7	36	36.6
5	B/o SARALA	35.9	36.4	37	37.2
6	B/o USHA	37.4	37.8	38	38.5
7	B/o MAHALAKSHMI	36.5	37.0	37	38.0
8	B/o LATHA	36.7	37.1	38	38.2
9	B/o JEYALAKSHMI	35.7	36.1	37	37.1
10	B/o THAVAMANI	36.1	36.6	37	37.5
11	B/o GEETHA KUMAR	36.7	37.1	38	38.0
12	B/o SANTHANA MARI	36.9	37.2	38	38.1
13	B/o VIJI	35.7	36.2	37	37.1
14	B/o GANDHIMATHY	36.5	36.9	37	37.9
15	B/o REVATHY	36.9	37.4	38	38.2
16	B/o GANGA DEVI	36.1	36.5	37	37.5
17	B/o SEETHA	34.7	35.2	36	36.2
18	B/o NADHIYA	34.5	34.9	35	36.0
19	B/o DEIVARATCHAGI	36.1	36.5	37	37.5
20	B/o AARTHY	35.0	35.4	36	36.4
21	B/o VEERASELVI	37.2	37.7	38	38.5
22	B/o KAROLINE	35.1	35.5	36	36.5
23	B/o CHITHRA	36.2	36.7	37	37.7
24	B/o SUMITHRA	36.1	36.6	37	37.4
25	B/o SANKARI	34.9	35.4	36	36.4
26	B/o SANDHYA	34.9	35.4	36	36.4
27	B/o NEELA VENI	35.9	36.4	37	37.4
28	B/o JAYAMALINI	35.6	36.0	37	37.1
29	B/o RADHIKA	36.2	36.7	37	37.5
30	B/o ARCHANA	35.0	35.9	36	36.9
31	B/o MANGAI	36.4	36.9	37	37.9
32	B/o DEVI	34.7	35.1	36	36.1
33	B/o JEYA	35.6	36.0	37	37.0
34	B/o GOWTHAMI	36.4	36.9	37	37.9
35	B/o SEETHA	35.6	36.0	36	37.0
36	B/o SENTHAMARAI	34.7	35.1	36	36.1
37	B/o RUBINI	36.1	36.6	37	37.5
38	B/o GEETHA	34.6	35.1	36	36.1
39	B/o TAMILARASI	35.0	35.4	36	36.4
40	B/o RAMYA	35.9	36.4	37	37.4
41	B/o SATHYA	35.6	36.1	37	37.1
42	B/o SOUNDARYA	36.0	36.4	37	37.4

43	B/o KAMALA	36.9	37.4	38	38.3
44	B/o SELVI	36.4	36.9	37	37.8
45	B/o DEVI	36.1	36.6	37	37.5
46	B/o AMUDHA	35.8	36.0	36	36.9
47	B/o VALARMATHY	34.5	34.9	35	35.9
48	B/o VENNILA	36.0	36.4	37	37.3
49	B/o JEYANTHI	35.2	35.7	36	36.6
50	B/o SUMATHY	36.0	36.4	37	37.4

TERM - APPROPRIATE FOR GESTATIONAL BABIES - HEAD CIRCUMFERENCE

SL. No	NAME	HC_7	HC_14	HC_21	HC_28
1	B/o STELLA	37.1	37.6	38	38.5
2	B/o VIJAYALAKSHMI	36.9	37.4	38	38.3
3	B/o NALINI	36.1	36.6	37	37.5
4	B/o SARASWATHY	36.0	36.5	37	37.4
5	B/o BHUVANESHWARI	37.0	37.4	38	38.3
6	B/o PRIYA	37.0	37.5	38	38.4
7	B/o DHANALAKSHMI	36.2	36.7	37	37.7
8	B/o PRAMILA	37.2	37.6	38	38.4
9	B/o RAMANI	37.2	37.6	38	38.4
10	B/o PREMA	36.7	37.1	38	38.0
11	B/o KANCHANA	37.2	37.6	38	38.4
12	B/o SANGEETHA	36.3	36.8	37	37.8
13	B/o VISALATCHI	36.1	36.6	37	37.5
14	B/o VIJAYALAKSHMI	35.0	35.5	36	36.5
15	B/o AGASTHIA	37.0	37.4	38	38.3
16	B/o SURYA	36.8	37.2	38	38.2
17	B/o DEEPA	36.6	37.1	38	38.0
18	B/o SARANYA	36.0	36.5	37	37.5
19	B/o DEVI	37.0	37.4	38	38.3
20	B/o ELLAMMMA	35.8	36.3	37	37.4
21	B/o RAASATHI	37.0	37.5	38	38.4
22	B/o VAIDEGI	36.7	37.2	38	38.2
23	B/o SAVITHRI	37.0	37.5	38	38.4
24	B/o FARHANA	37.0	37.5	38	38.4
25	B/o AMMANI	37.0	37.5	38	38.4
26	B/o KAVITHA	37.0	37.5	38	38.4
27	B/o PREETHA	36.3	36.9	37	37.9
28	B/o SUMATHY	37.0	37.5	38	38.4
29	B/o DEEPA	37.0	37.5	38	38.4
30	B/o KAVITHA	35.9	36.4	37	37.4
31	B/o DEVI	36.4	36.9	37	37.9
32	B/o SARANYA	36.0	36.5	37	37.5
33	B/o SANGEETHA	37.2	37.7	38	38.7
34	B/o RAMYA	36.0	36.5	37	37.5
35	B/o REVATHY	36.1	36.6	37	37.7
36	B/o SEETHA	37.0	37.5	38	38.4
37	B/o NADHIYA	35.7	36.2	37	37.0
38	B/o USHA	35.5	36.0	37	37.0
39	B/o SUMATHY	35.4	35.9	36	36.8
40	B/o LATHA	36.1	36.6	37	37.5
41	B/o LAKSHMI	36.7	37.1	38	38.1
42	B/o SHALINI	37.1	37.5	38	38.4

43	B/o KAMALA	36.8	37.2	38	38.2
44	B/o REVATHY	36.2	36.7	37	37.7
45	B/o SARITHA	36.8	37.2	38	38.2
46	B/o GEETHA	36.2	36.7	37	37.7
47	B/o PRIYA	37.0	37.5	38	38.4
48	B/o SARANYA	36.1	36.6	37	37.6
49	B/o NADHIYA	37.0	37.5	38	38.4
50	B/o LATHA	37.0	37.5	38	38.4